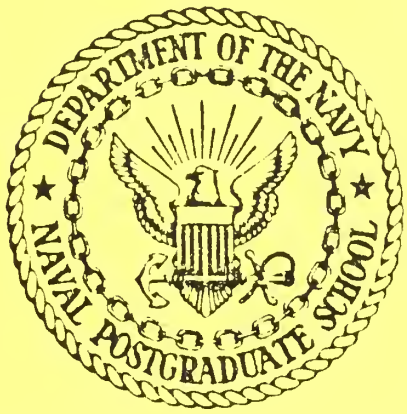
NPS68-85-007

NAVAL POSTGRADUATE SCHOOL

Monterey, California



HYDROGRAPHIC DATA FROM THE OPTOMA PROGRAM
OPTOMA9 20-25 February, 1984
OPTOMASF 3-4 March, 1984
OPTOMA10 23-24 April, 1984

by

Paul A. Wittmann
Michele. M. Rienecker
Edward A. Kelley, Jr.
Christopher N.K. Mooers

February 1985

Prepared for:
Office of Naval Research
Environmental Sciences Directorate (Code 420)
Arlington, VA 22217

NAVAL POSTGRADUATE SCHOOL
Monterey, California 93943

Commodore R.H. Shumaker
Superintendent

David A. Schrady
Provost

This report is for the research project "Ocean Prediction Through Observations, Modeling and Analysis" sponsored by the Physical Oceanography Program of the Office of Naval Research under Program Element 61153N.

This report was Prepared by:

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NPS68-85-007

2. GOVT ACCESSION NO.:

3. RECIPIENT'S CATALOG NUMBER:

4. TITLE *(and Subtitle)*: HYDROGRAPHIC DATA FROM THE OPTOMA PROGRAM
OPTOMA9, 20-25 February 1984
OPTOMASF, 3-4 March 1984
OPTOMA10, 23-24 April 1984

5. TYPE OF REPORT & PERIOD COVERED: Report for October 1982 to February 1985.

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Paul A. Wittmann, Michele M. Rienecker, Edward A. Kelley, Jr., Christopher N.K. Mooers

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Postgraduate School
Monterey, CA 93943

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 61153N
N0001484WR24051

11. CONTROLLING OFFICE NAME AND ADDRESS: Office of Naval Research (Code 420)
Arlington, VA 22217

12. REPORT DATE: February 1985

13. NUMBER OF PAGES: (60)

14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*:

15. SECURITY CLASS. *(of this report)*: Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT *(of this Report)*: Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*:

18. SUPPLEMENTARY NOTES:

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*:
California Current System
Physical Oceanography
Dynamic Oceanography

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*:

The cruises OPTOMA9, OPTOMASF, and OPTOMA10 were undertaken in February, March and April of 1984 to sample subdomains of the California Current System. This report presents the hydrographic data, acquired by XBT and CTD casts, from the cruises.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

Hydrographic Data from the **OPTOMA** *Program:*

OPTOMA9

20 - 25 *February, 1984*

OPTOMA SF

3 - 4 *March, 1984*

OPTOMA10

23 - 24 *April, 1984*

by

Paul A. Wittmann
Michele M. Rienecker
Edward A. Kelley, Jr.
Christopher N. K. Mooers

Chief Scientist: C. N. K. Mooers

The **OPTOMA** Program is a joint program of

Department of Oceanography
Naval Postgraduate School
Monterey, CA 93943.

Center for Earth and Planetary Physics
Harvard University
Cambridge, MA 02138.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

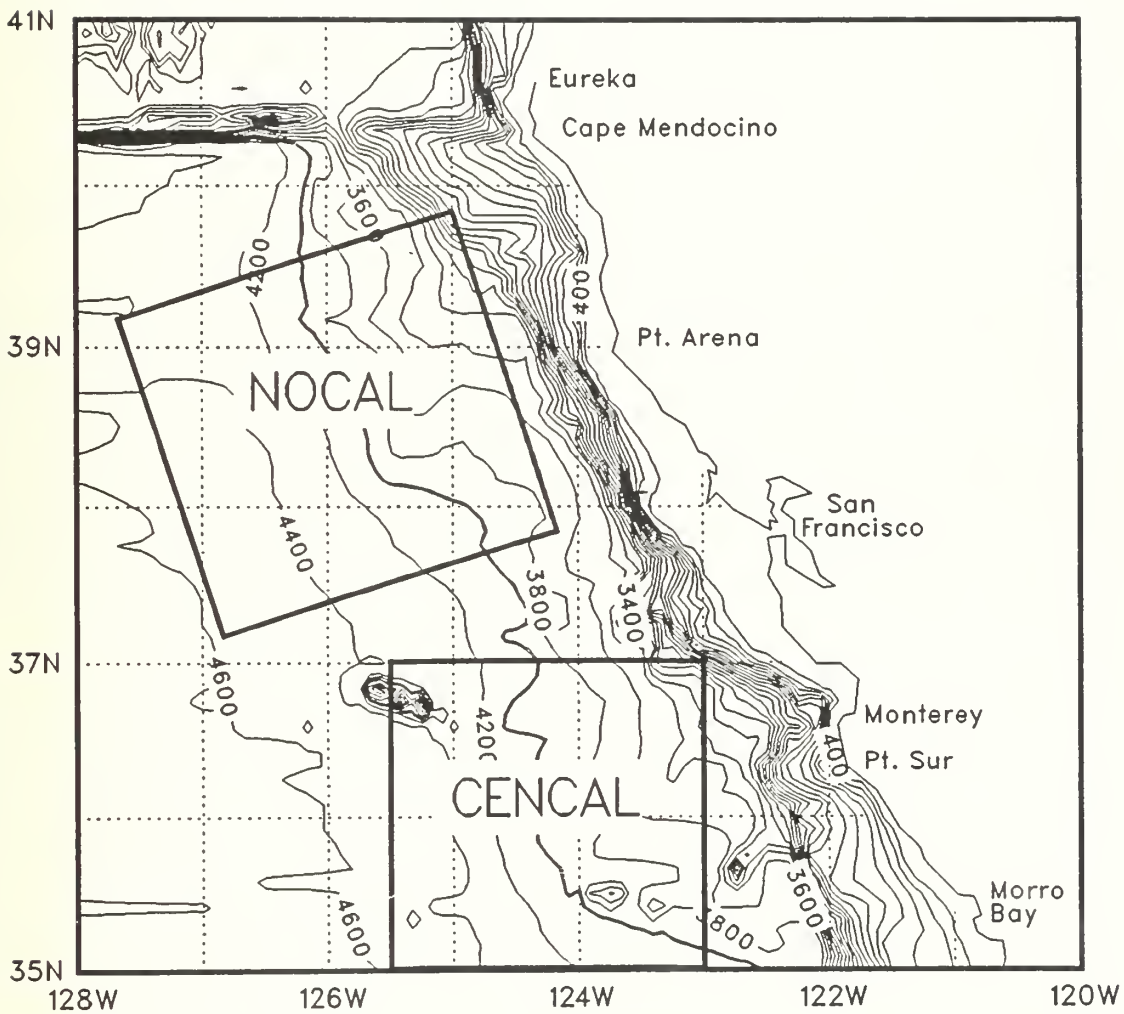


Figure 1: The NOCAL and CENCAL subdomains of the OPTOMA Program. Isobaths are shown in meters.

INTRODUCTION

The OPTOMA (Ocean Prediction Through Observations, Modeling and Analysis) Program, a joint NPS/Harvard program sponsored by ONR, seeks to understand the mesoscale (fronts, eddies, and jets) variability and dynamics of the California Current System and to determine the scientific limits to practical mesoscale ocean forecasting. To help carry out the aims of this project, a series of cruises has been planned in two subdomains, NOCAL and CENCAL, shown in Figure 1.

The three cruises presented in this report, OPTOMA9, OPTOMASF, and OPTOMA10, were undertaken aboard the R/V ACANIA.

The cruise OPTOMA9 was conducted from 20 to 25 February, 1984 and covered part of the CENCAL domain. Hydrographic data were acquired in an area 180 km cross-shore by 170 km alongshore, centered about 150 km offsore, with additional transects to and from the domain as shown in Figure 2. The track pattern consisted of three diamonds with parallel tracks, separated by roughly 60 km, along which hydrographic stations were occupied every 10 km.

The cruise OPTOMASF was conducted on 3 and 4 March, 1984 and covered the shelf region between Monterey, CA and San Francisco, CA. Hydrographic data were acquired in an area 75 km cross-shore by 150 km alongshore, as shown in Figure 13. The track pattern consisted of three alongshore transects and two cross shelf transects, along which hydrographic stations were occupied every 10 km.

The cruise OPTOMA10 was conducted on 23 and 24 April, 1984 and was originally planned to cover part of the CENCAL region. However, due to rough weather conditions, the cruise was aborted after the completion of one transect, shown in Figure 28. Hydrographic stations were occupied every 10 km.

Transect extremes are identified by letter on the cruise tracks for OPTOMA9, OPTOMASF and OPTOMA10, in Figures 2, 13, and 28, respectively, to aid in cross referencing the data in subsequent Figures.

DATA ACQUISITION

Data acquired during OPTOMA9, OPTOMASF, and OPTOMA10 include XBT and CTD profiles and continuous 2 m thermalsalinograph measurements. A bucket surface temperature and a water sample for salinity were taken at every CTD station. These surface values and those at 2 m were used for calibration purposes as well as contributions to the data base. Continuous meteorological data such as atmospheric pressure at a height of 2 m and wind speed and direction at a height of 20 m and intermittent acoustic Doppler velocity data were also recorded. The XBT, CTD and continuous "underway" data were digitized using a HP 5328 frequency counter and a 40 channel digital voltmeter. The continuous data were averaged over two-minute intervals. All data were recorded, using an HP 9835 computer, on data cassettes and transferred ashore to the IBM 3033 mainframe computer for editing and processing.

Station positions were determined by Loran C fixes and are claimed to be accurate to within about 0.1 km. Table 1 on page 6 summarizes the various sensors available on the R/V ACANIA and their accuracy. The bottle surface salinity samples were determined ashore by a Guildline Model 8400 "Autosal" salinometer with an accuracy of $\pm$0.003 ppt.

DATA PROCESSING

Data processing, such as estimating depth profiles for the XBT temperature profiles based on the XBT's descent speed, and conversion of CTD conductivity to salinity using the algorithm given in Lewis and Perkin (1981), was carried out on the IBM 3033 at the Naval Postgraduate School. The data were then edited by removing obvious salinity spikes and eliminating cast failures that were not

identified during the cruise. The percentage of casts retained were 99%, 95%, and 100% for OPTOMA9, OPTOMASF, and OPTOMA10, respectively. From a comparison c the CTD surface salinities with the surface salinities from the bottle samples i was determined that no correction to the CTD salinities was needed. The CTD dat were interpolated to 5 m intervals and then up and down casts were averaged.

The data have been transferred on digital tape to the National Oceanographic Data Center in Washington, DC.

DATA PRESENTATION

The data from OPTOMA9, OPTOMASF, and OPTOMA10 are presented in sections 1, 2, and 3 respectively. The cruise track, station locations (with XBT's and CTD's identified) and station numbers are shown in the first three figures of each section. These figures are followed by a listing of the stations, with their coordinates, the date and time at which the station was occupied, and the surface information obtained at the station.

Vertical profiles of temperature from the XBT casts are shown in staggered fashion. The location of these profiles may be found by reference to the various maps of the cruise tracks. Transect extremes are identified as nearly as possible. The first profile on each plot is shown with its temperature unchanged; to each subsequent profile an appropriate multiple of 5C has been added. Vertical profiles from the CTD's follow. Profiles of temperature are staggered by 5C and those of salinity by 4 ppt.

Isotherms for each transect are shown in the next pages, followed by isopleths of temperature, salinity and sigma-t from the CTD's in sections 1 and 2. Based on instrument accuracy and the vertical temperature gradient, it is estimated that depths of isotherms in the main thermocline are uncertain to $\pm$20m The tick marks identify station positions and, again, the transect extremes are shown on these plots.

Section 1 includes mean profiles of temperature from the XBT's. In addition mean profiles of temperature, salinity and sigma-t from the CTD's are given as well as a scatter diagram of the T-S pairs and the mean S(T) curve with the $\pm$ standard deviation envelope. This section concludes with a plot of the mean N^2 (Brunt-Vaisala frequency squared) profile with $\pm$ the standard deviation. On the sigma-t and N^2 plots, the appropriate profiles derived from the mean temperature and mean salinity profiles are also shown.

Section 2 contains similar profiles as those in Section 1, except that the CTD and XBT casts were combined, and then subdivided according to the maximum depth of each cast. Plots are given from all casts less than 150 meters depth, and from all casts greater than 300 meters depth to contrast and compare the hydrographic properties of on shelf and off shelf water masses.

Section 3 concludes with the mean temperature profile from all casts.

Table 1: Scientific instruments aboard the R/V ACANIA

	Instrument	Variable	Sensor	Accuracy	Resolution
	Neil Brown CTD Mark IIIb	pressure	strain gage	1.6 db	0.025 db
		temperature	thermistor	0.005 C	0.0005 C
		conductivity	electrode cell	0.005 mmho	0.001 mmho
	Sippican BT	temperature	thermistor	0.2 C	
		depth	descent speed	greater of 4.6 m and 2% of depth	
*	Guildline Autosal	conductivity	electrode cell	0.003 ppt	0.0002 ppt
#	Amatek straza ADVP	velocity profiles to 100m	4 beam sonar	3 cm/sec relative to ship speed	3 cm/sec
	Rosemount Sensor	sea surface temperature	platinum thermometer	0.05 C	0.005 C
	Sea-Bird Sensors	temperature	thermistor	0.003 C	0.0005 C
		conductivity at 2 meters	electrode cell	0.003 mmho	0.0005 mmho
	Rosemount Sensor	air temperature	thermometer	0.01 C	
	Kavolico Barometer	atmospheric pressure	pressure transducer	1.5 mb	0.1 mb
*	1200 EPS Hygrometer	dew point	condensation temp. sensor	0.2 C	0.02 C
	Meteorology Res. Inc.	wind speed	anemometer	0.15 mph or 1%	
	Meteorology Res. Inc.	wind direction	vane	2.5 degrees	
	Internav LC408 LORAN C	position	two chain LORAN receiver	100 meters	10 meters
	Motorola Miniranger	position	microwave transponders	4 meters	2 meters

* Not operating on the OPTOMA9 cruise.
\# Intermittent

SECTION 1
OPTOMA9
20 - 25 FEBRUARY 1984

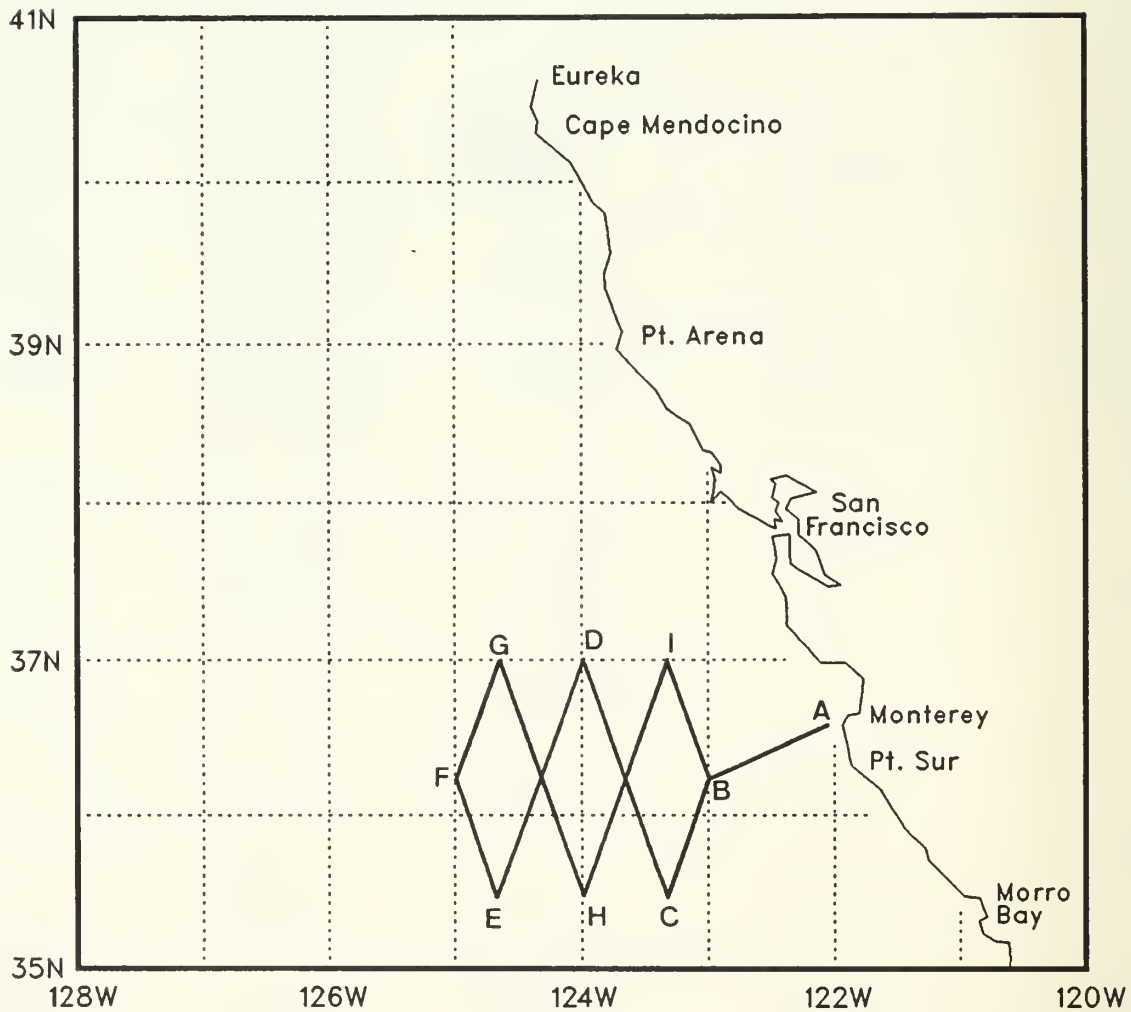


Figure 2: The cruise track for OPTOMA9.

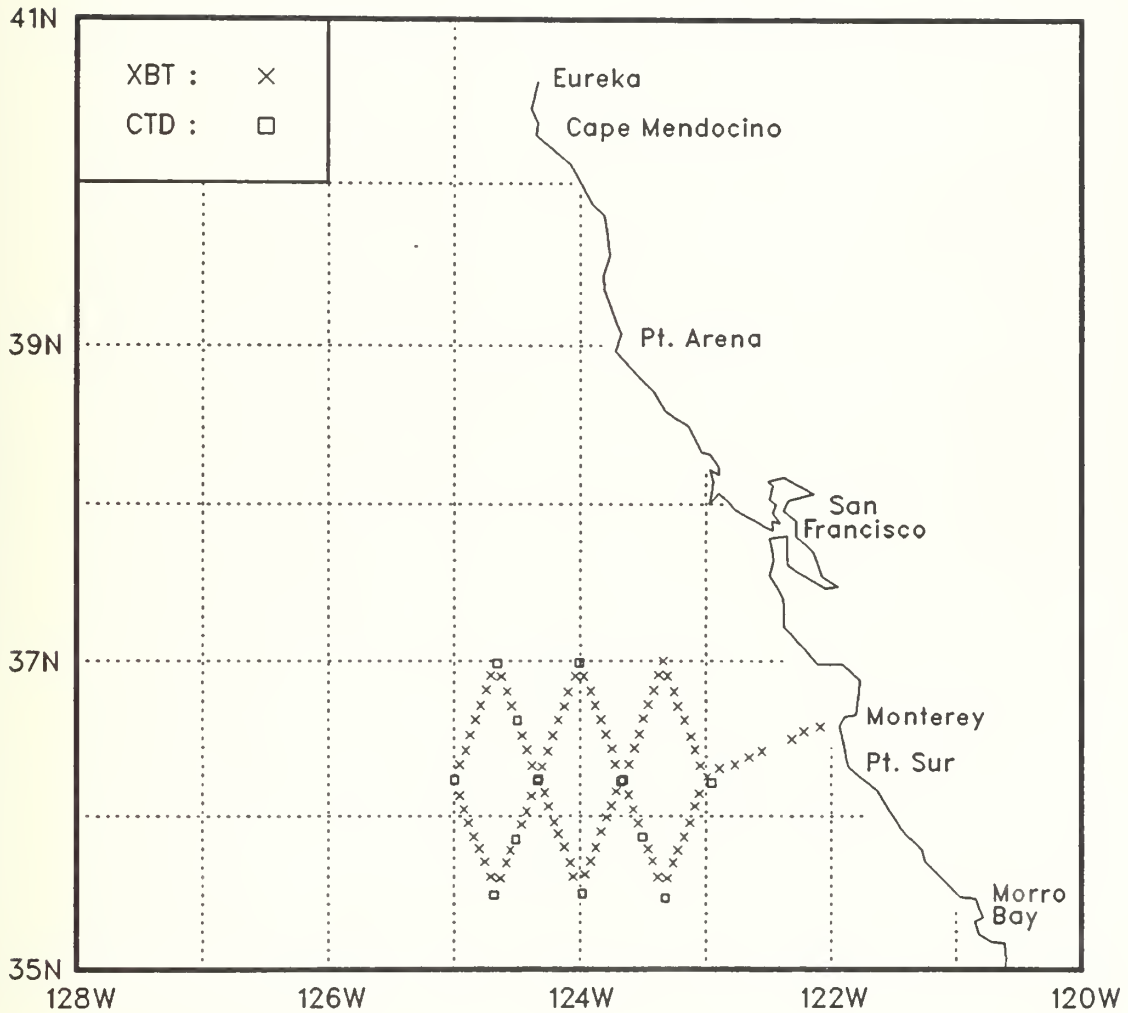


Figure 3: XBT and CTD station locations for OPTOMA9.

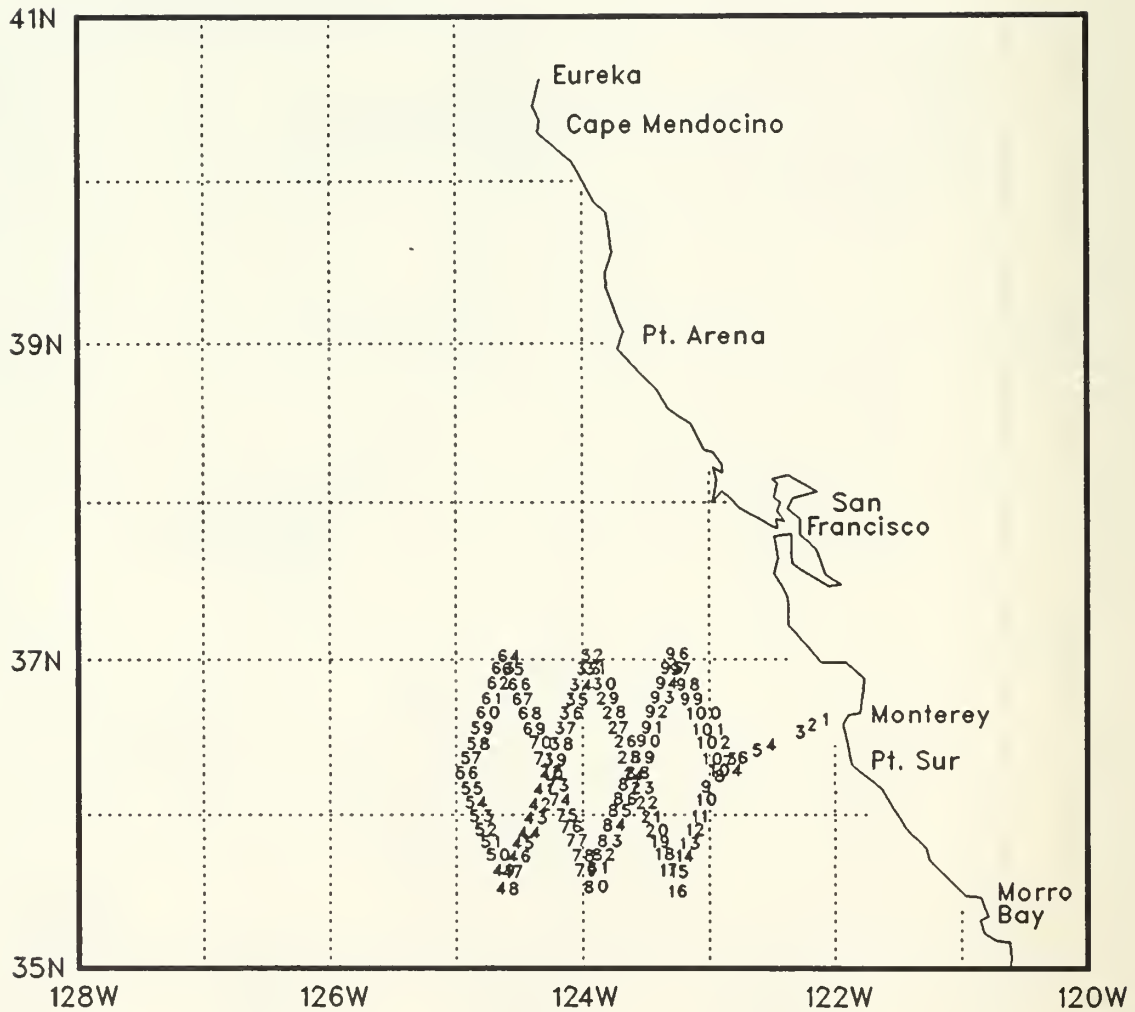


Figure 4: Station numbers for OPTOMA9.

Table 2: OPTOMA9 Station Listing

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
1	XBT	83051	1954	36.35	122.05	12.8			
2	XBT	84051	2038	36.33	122.13	13.0			
3	XBT	84051	2114	36.30	122.18	13.2			
4	XBT	84051	2239	36.25	122.33	13.2			
5	XBT	84051	2317	36.23	122.39	13.0			
6	XBT	84051	2357	36.20	122.46	13.1			
7	XBT	84052	39	36.18	122.53	13.2			
8	CTD	84052	11	36.13	122.57	13.2	32.70	13.4	32.78
9	XBT	84052	358	36.09	123.03	13.0			
10	XBT	84052	434	36.04	123.05	13.2			
11	XBT	84052	516	35.57	123.07	13.0			
12	XBT	84052	554	35.52	123.10	13.3			
13	XBT	84052	633	35.47	123.13	13.1			
14	XBT	84052	706	35.42	123.15	13.2			
15	XBT	84052	749	35.36	123.18	13.5			
16	CTD	84052	18	35.28	123.19	13.5	32.78	13.6	32.82
17	XBT	84052	1134	35.36	123.23	13.5			
18	XBT	84052	1238	35.43	123.25	13.3			
19	XBT	84052	1325	35.47	123.27	13.1			
20	CTD	84052	1444	35.52	123.30	13.1	32.40	13.1	32.43
21	XBT	84052	1554	35.57	123.32	12.9			
22	XBT	84052	1657	36.03	123.34	13.0			
23	XBT	84052	1811	36.08	123.37	12.8			
24	CTD	84052	2105	36.14	123.40	12.8	32.41	12.8	32.46
25	XBT	84052	2239	36.20	123.43	12.6			
26	XBT	84053	12	36.26	123.45	12.6			
27	XBT	84053	140	36.32	123.47	12.6			
28	XBT	84053	417	36.38	123.50	12.5			
29	XBT	84053	645	36.43	123.53	12.6			
30	XBT	84053	853	36.49	123.55	12.6			
31	XBT	84053	1106	36.54	123.58	12.6			
32	CTD	84053	1349	37.00	124.00	12.7	32.37	13.0	32.38
33	XBT	84053	1437	36.54	124.02	12.5			
34	XBT	84053	1530	36.48	124.05	12.5			
35	XBT	84053	1615	36.43	124.07	12.5			
36	XBT	84053	1659	36.37	124.10	12.6			
37	XBT	84053	1748	36.31	124.13	12.7			
38	XBT	84053	1833	36.25	124.15	12.3			
39	XBT	84053	1921	36.19	124.18	12.5			
40	CTD	84053	2052	36.14	124.20	12.8	32.61	13.7	32.68
41	XBT	84053	2150	36.08	124.23	12.9			
42	XBT	84053	2243	36.02	124.25	12.8			
43	XBT	84053	2331	35.57	124.28	13.2			
44	CTD	84054	48	35.51	124.30	13.7	32.89	13.7	32.92
45	XBT	84054	128	35.47	124.33	13.7			

STN	TYPE	YR/DAY	GMT	LAT (NORTH) DD.MM	LONG (WEST) DDD.MM	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
46	XBT	84054	209	35.42	124.35	13.5			
47	XBT	84054	257	35.36	124.38	13.9			
48	CTD	84054	442	35.29	124.41	14.3	33.09	14.4	33.21
49	XBT	84054	630	35.36	124.42	14.4			
50	XBT	84054	736	35.42	124.45	13.8			
51	XBT	84054	827	35.47	124.48	13.8			
52	XBT	84054	915	35.52	124.51	13.9			
53	XBT	84054	1006	35.57	124.53	14.1			
54	XBT	84054	1055	36.03	124.55	14.1			
55	XBT	84054	1144	36.08	124.57	14.1			
56	CTD	84054	1336	36.14	125.00	14.3	33.08	14.3	33.13
57	XBT	84054	1422	36.20	124.57	14.0			
58	XBT	84054	1505	36.26	124.54	14.0			
59	XBT	84054	1557	36.32	124.53	14.0			
60	XBT	84054	1644	36.38	124.50	14.5			
61	XBT	84054	1727	36.43	124.47	13.6			
62	XBT	84054	1814	36.49	124.45	13.3			
63	XBT	84054	1858	36.55	124.43	12.5			
64	CTD	84054	2022	36.59	124.39	12.8	32.75	12.9	32.81
65	XBT	84054	2058	36.54	124.37	12.2			
66	XBT	84054	2138	36.48	124.35	12.7			
67	XBT	84054	2217	36.43	124.33	12.7			
68	CTD	84054	2329	36.37	124.30	12.6	32.53	12.7	32.65
69	XBT	84055	12	36.31	124.28	12.8			
70	XBT	84055	50	36.26	124.25	13.1			
71	XBT	84055	132	36.20	124.23	13.2			
72	CTD	84055	247	36.15	124.19	12.5	32.51	13.1	32.64
73	XBT	84055	328	36.09	124.17	12.7			
74	XBT	84055	406	36.04	124.15	12.9			
75	XBT	84055	448	35.58	124.12	12.6			
76	XBT	84055	519	35.53	124.10	12.6			
77	XBT	84055	556	35.48	124.07	13.0			
78	XBT	84055	639	35.42	124.04	13.4			
79	XBT	84055	717	35.36	124.03	13.3			
80	CTD	84055	840	35.30	123.59	13.7	32.89	13.9	32.91
81	XBT	84055	944	35.37	123.57	13.1			
82	XBT	84055	1025	35.42	123.55	12.9			
83	XBT	84055	1107	35.48	123.52	12.8			
84	XBT	84055	1156	35.54	123.50	13.0			
85	XBT	84055	1238	36.00	123.47	12.7			
86	XBT	84055	1316	36.04	123.45	12.7			
87	XBT	84055	1401	36.10	123.42	12.6			
88	CTD	84055	1528	36.14	123.39	12.6	32.53	13.0	32.65
89	XBT	84055	1627	36.20	123.36	12.5			
90	XBT	84055	1722	36.26	123.34	12.5			

STN	TYPE	YR/DAY	GMT	LAT (NORTH) DD.MM	LONG (WEST) DDD.MM	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
91	XBT	84055	1810	36.32	123.32	12.6			
92	XBT	84055	1903	36.38	123.30	12.5			
93	XBT	84055	1958	36.43	123.27	12.6			
94	XBT	84055	2054	36.49	123.25	12.6			
95	XBT	84055	2152	36.55	123.22	12.6			
96	XBT	84055	2244	37.00	123.20	12.5			
97	XBT	84055	2333	36.54	123.18	12.6			
98	XBT	84056	26	36.48	123.15	12.6			
99	XBT	84056	114	36.43	123.13	12.8			
100	XBT	84056	204	36.37	123.10	12.6			
101	XBT	84056	300	36.31	123.07	12.6			
102	XBT	84056	343	36.26	123.05	12.7			
103	XBT	84056	433	36.20	123.02	12.8			
104	XBT	84056	514	36.15	122.59	12.7			

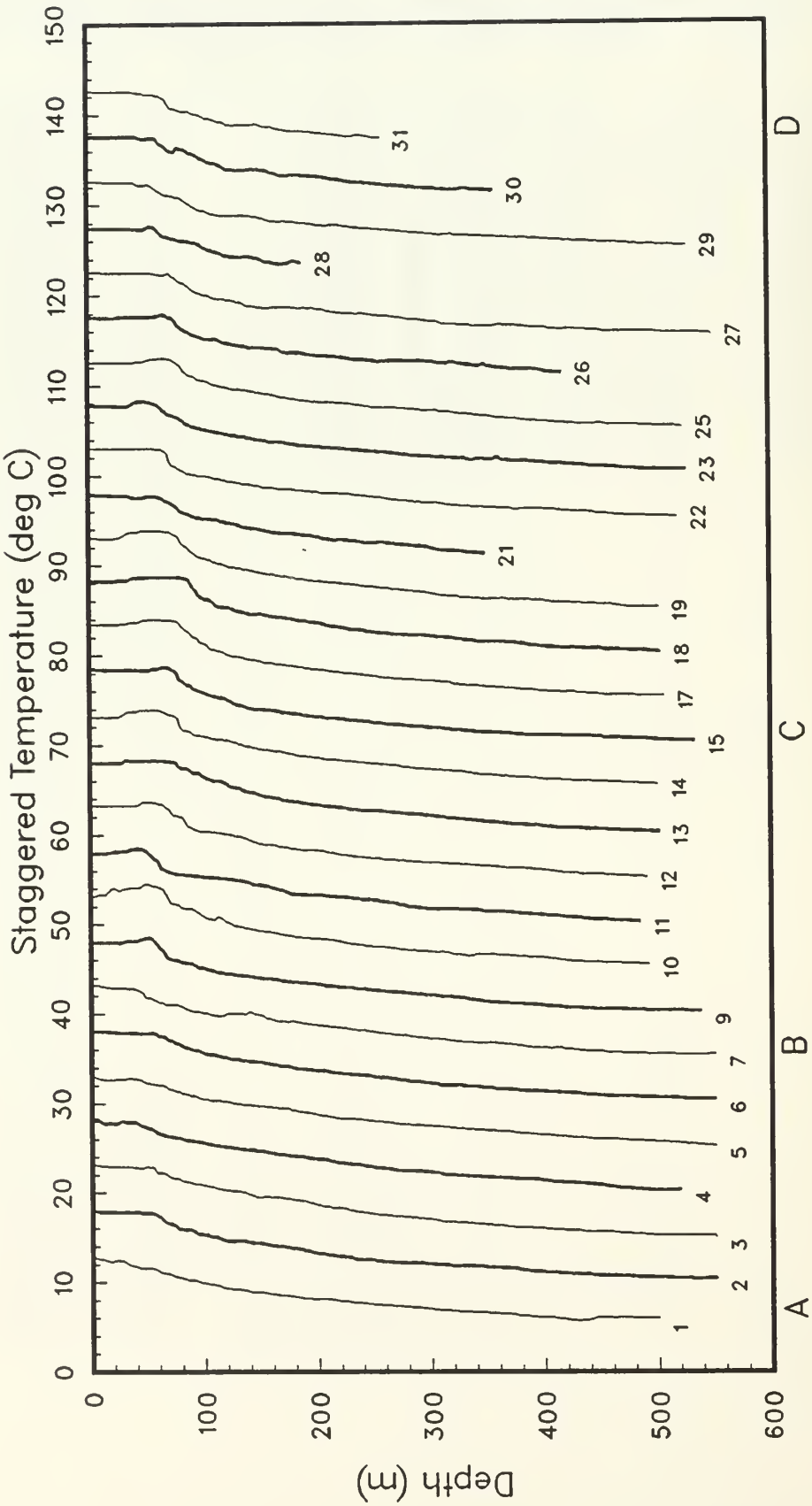


Figure 5(a): XBT temperature profiles, staggered by multiples of 5C. (OPTOMA9).

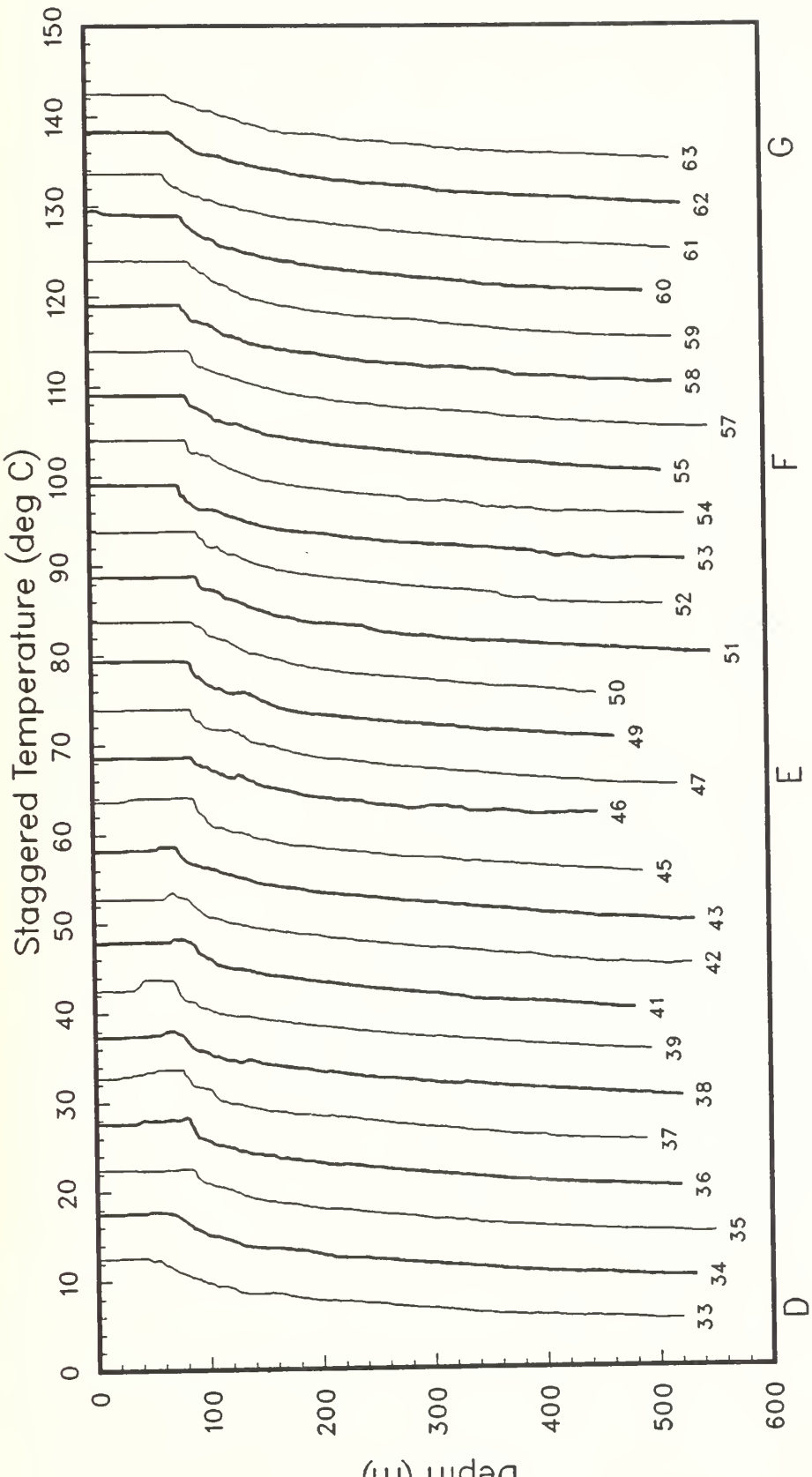

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
33
34
35
36
37
38
39
41
42
43
45
46
47
49
50
51
52
53
54
55
57
58
59
60
61
62
63
D
E
F
G

Figure 5(b).

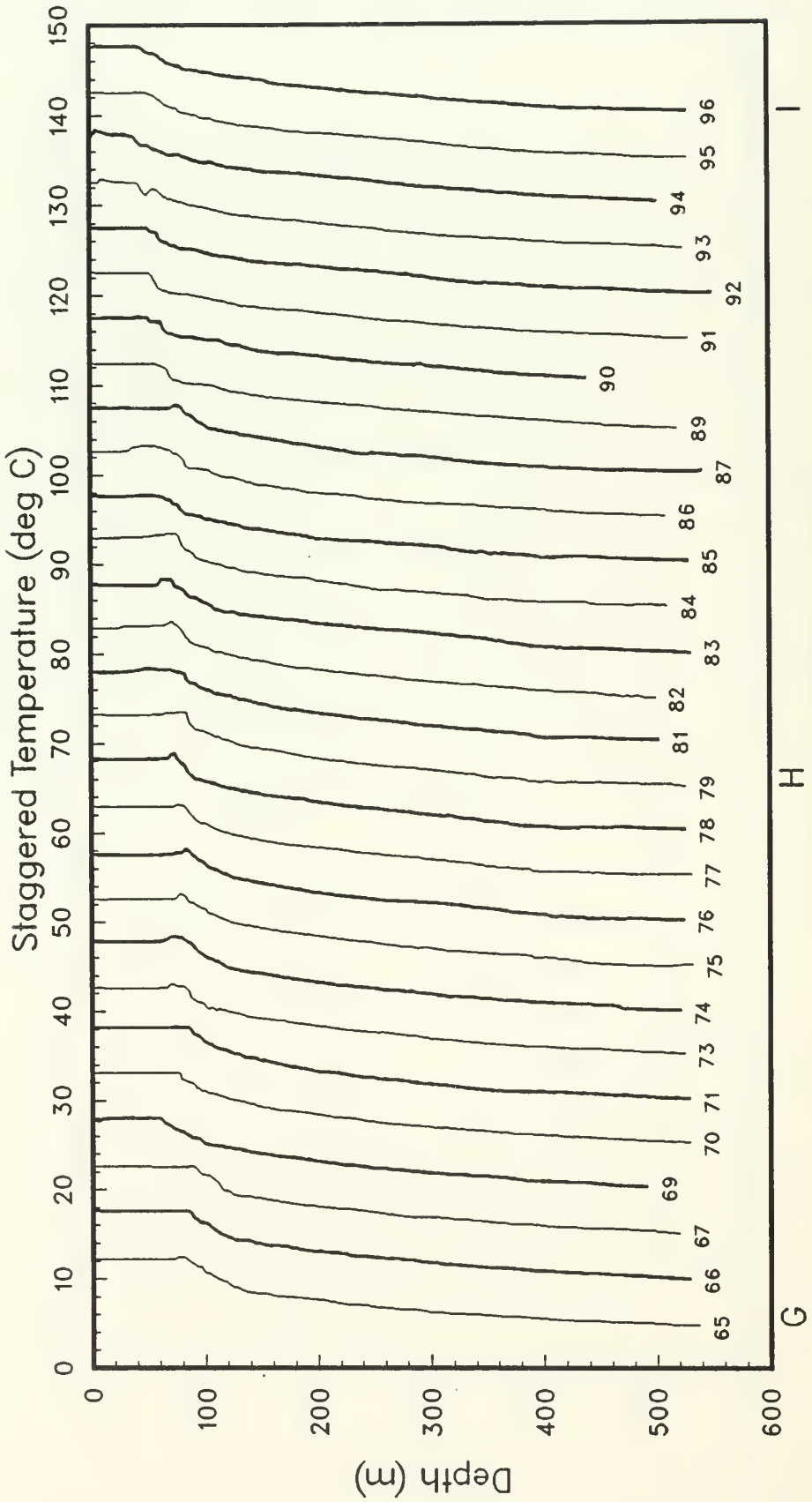

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
65
66
67
69
70
71
73
74
75
76
77
78
79
81
82
83
84
85
86
87
89
90
91
92
93
94
95
96
G
H
I

Figure 5(c).

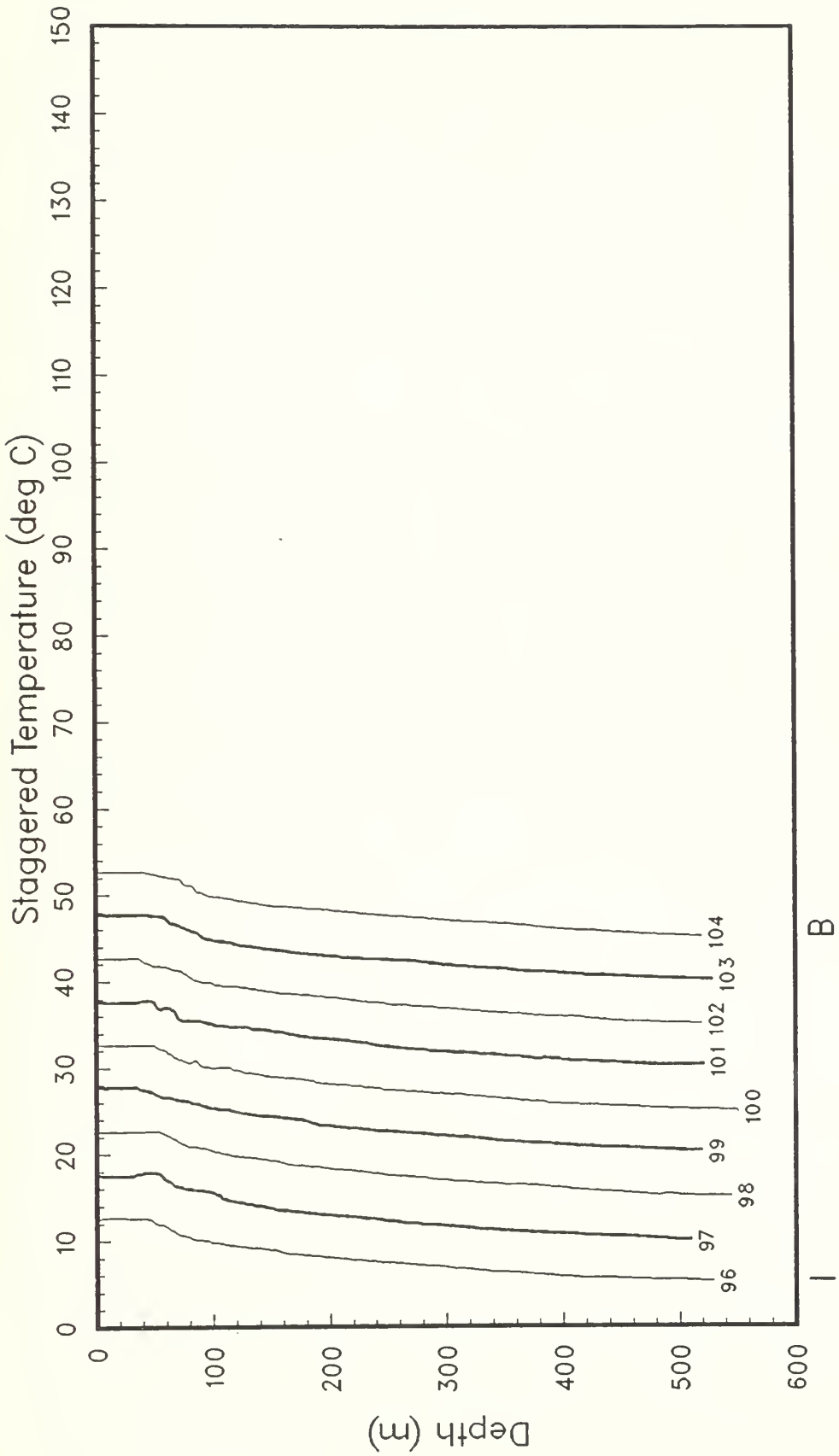

Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Depth (m)
0
100
200
300
400
500
600
96
97
98
99
100
101
102
103
104
A
B

Figure 5(d).

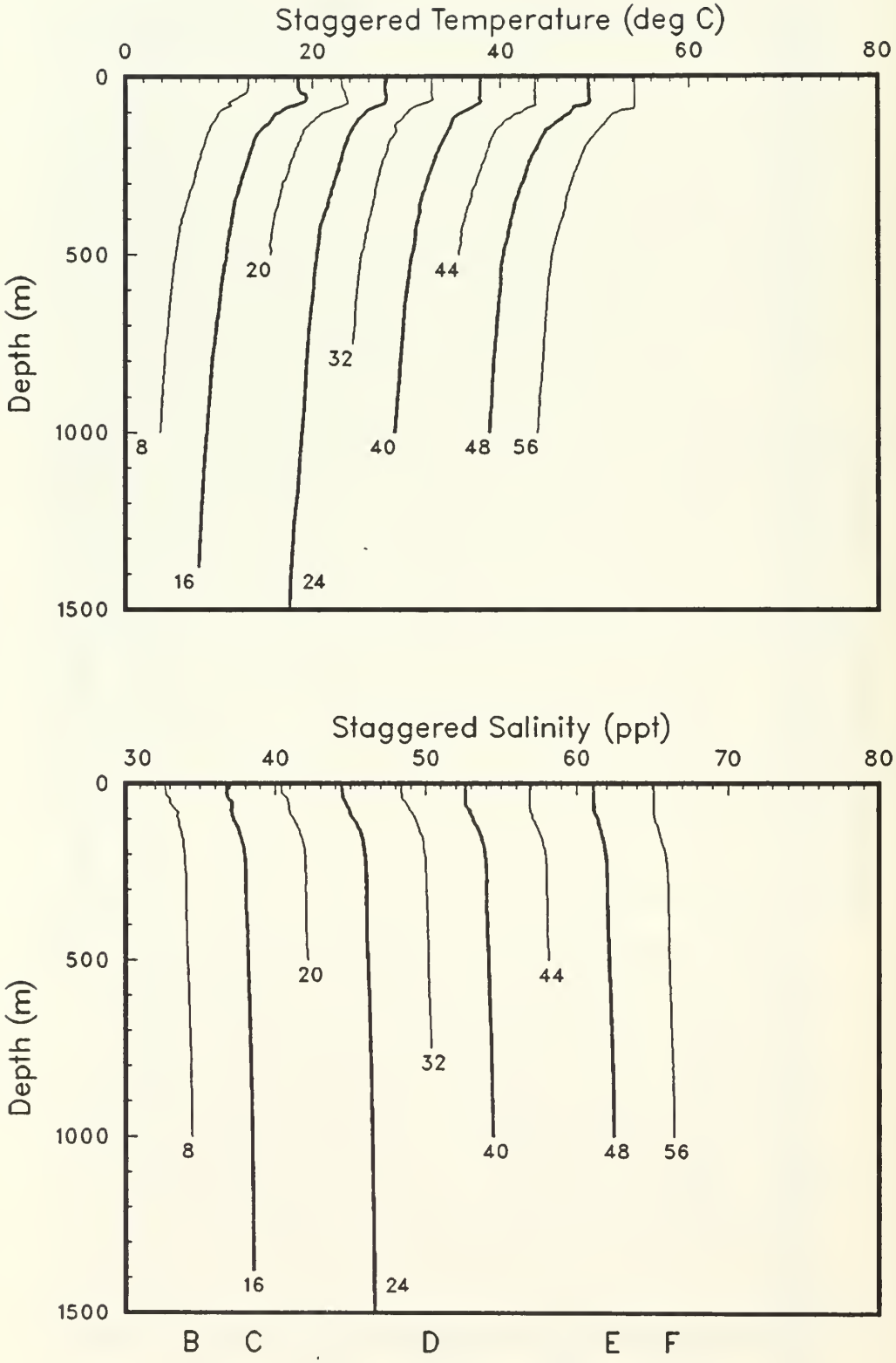


Figure 6(a): CTD temperature profiles, staggered by multiples of 5C, and salinity profiles, staggered by multiples of 4 ppt. (OPTOMA9).

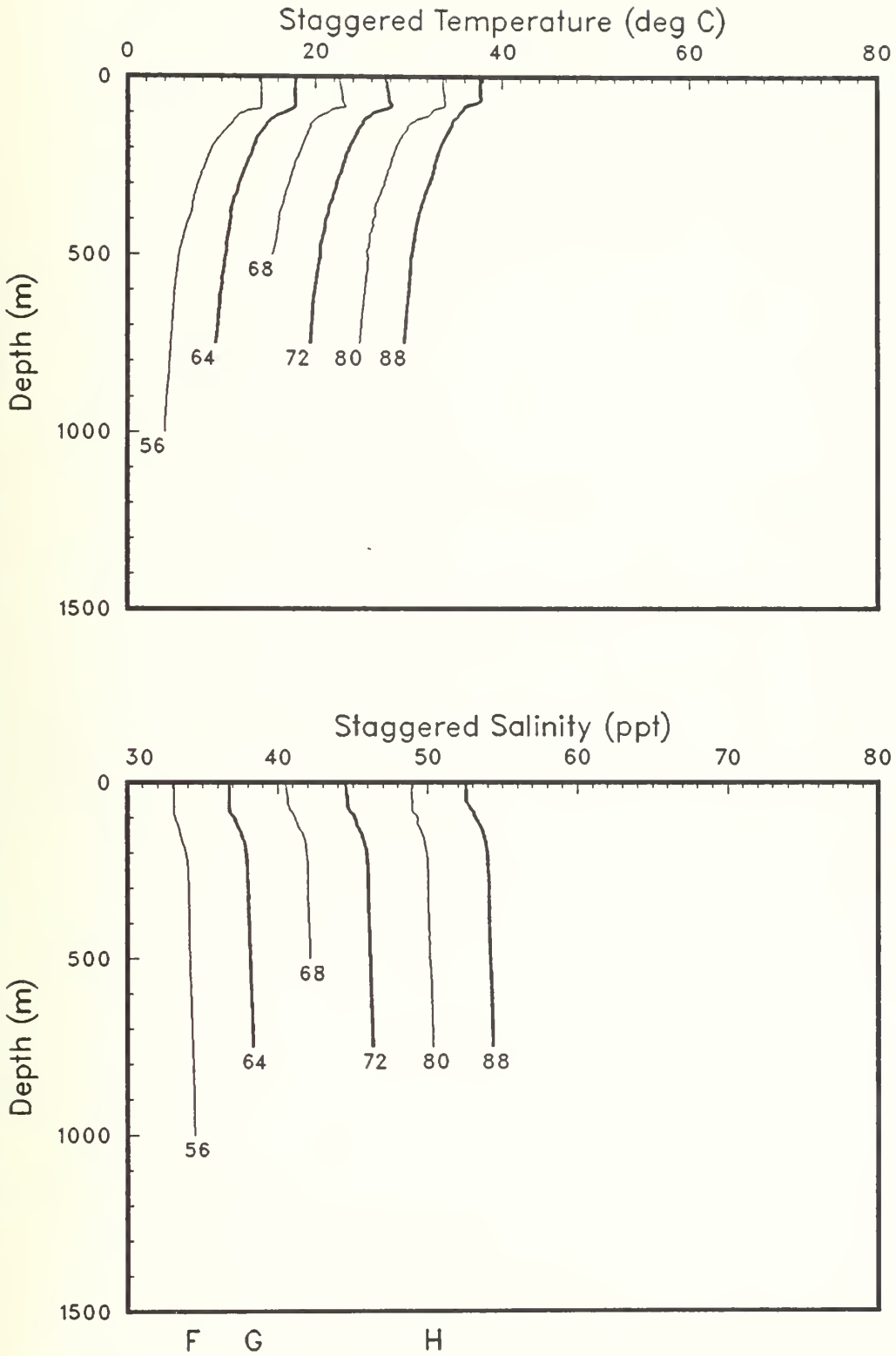

Staggered Temperature (deg C)
0
20
40
60
80
Depth (m)
0
500
1000
1500
56
64
68
72
80
88
Staggered Salinity (ppt)
30
40
50
60
70
80
0
500
1000
1500
56
64
68
72
80
88
F
G
H

Figure 6(b).

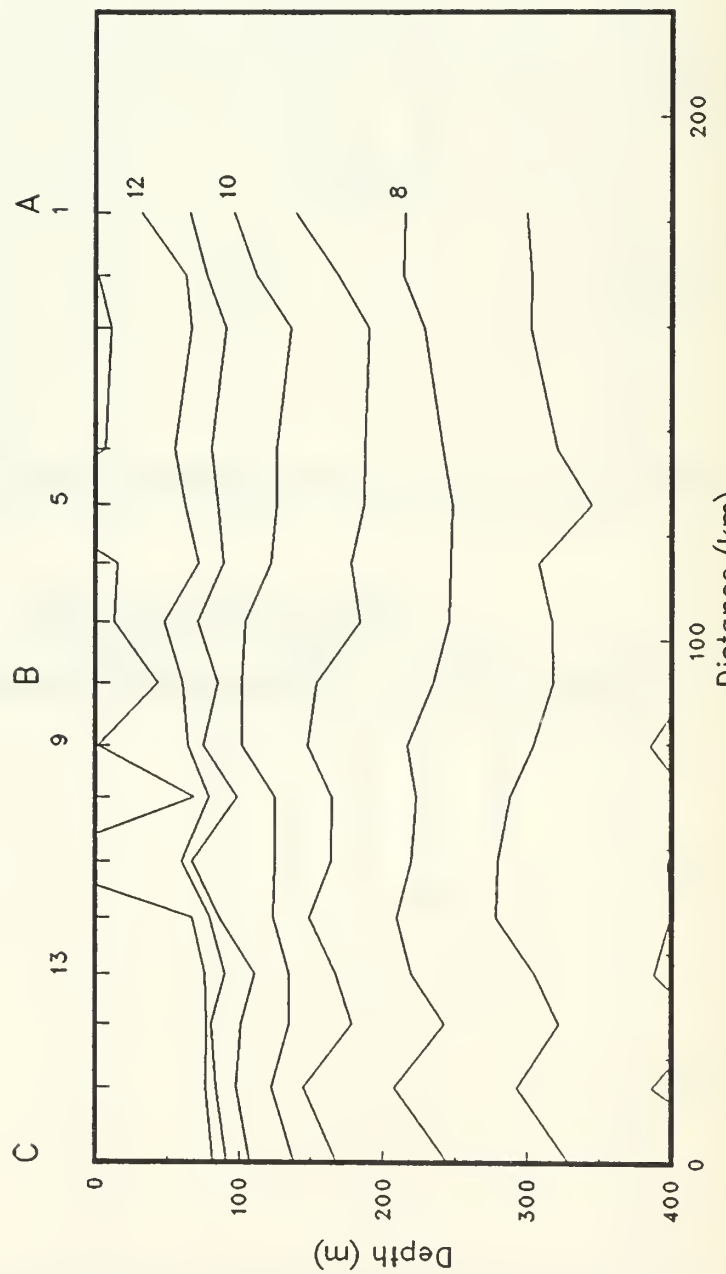


Figure 7(a): Along-track isotherms. Tick marks along the upper horizontal axis show station positions. Some station numbers are given. Dashed lines are used if the cast was too shallow. (OPTOMA9).

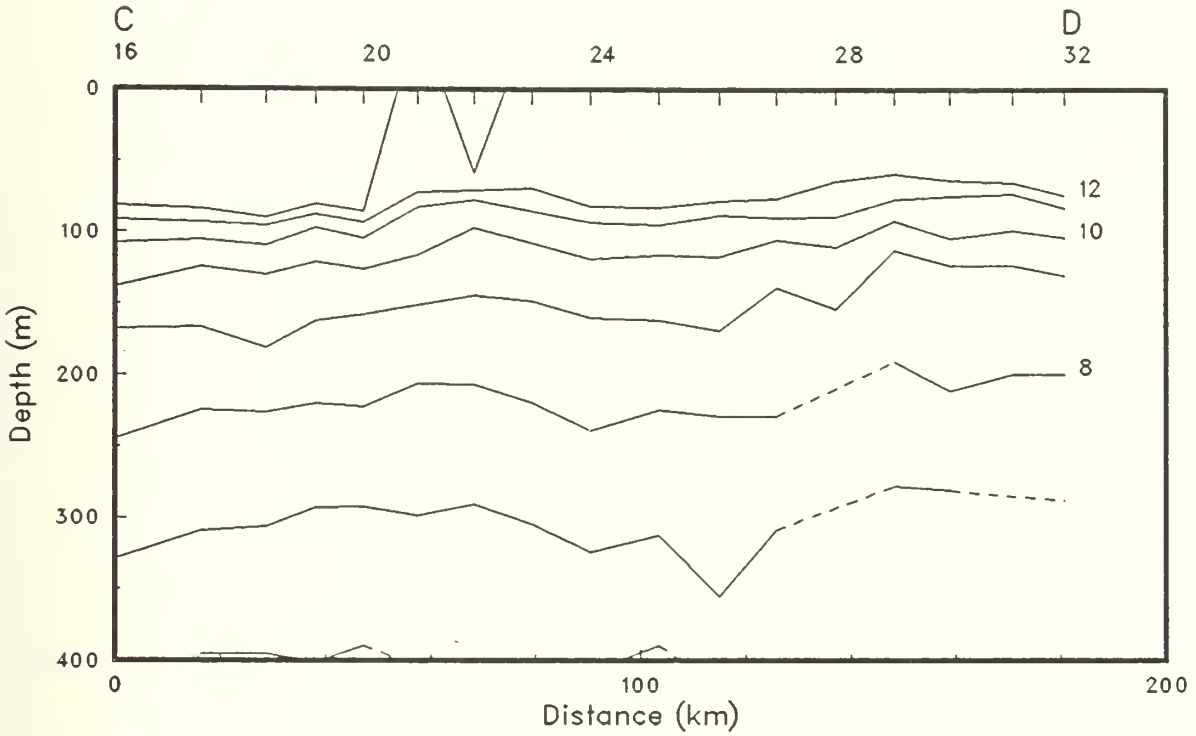


Figure 7(b).

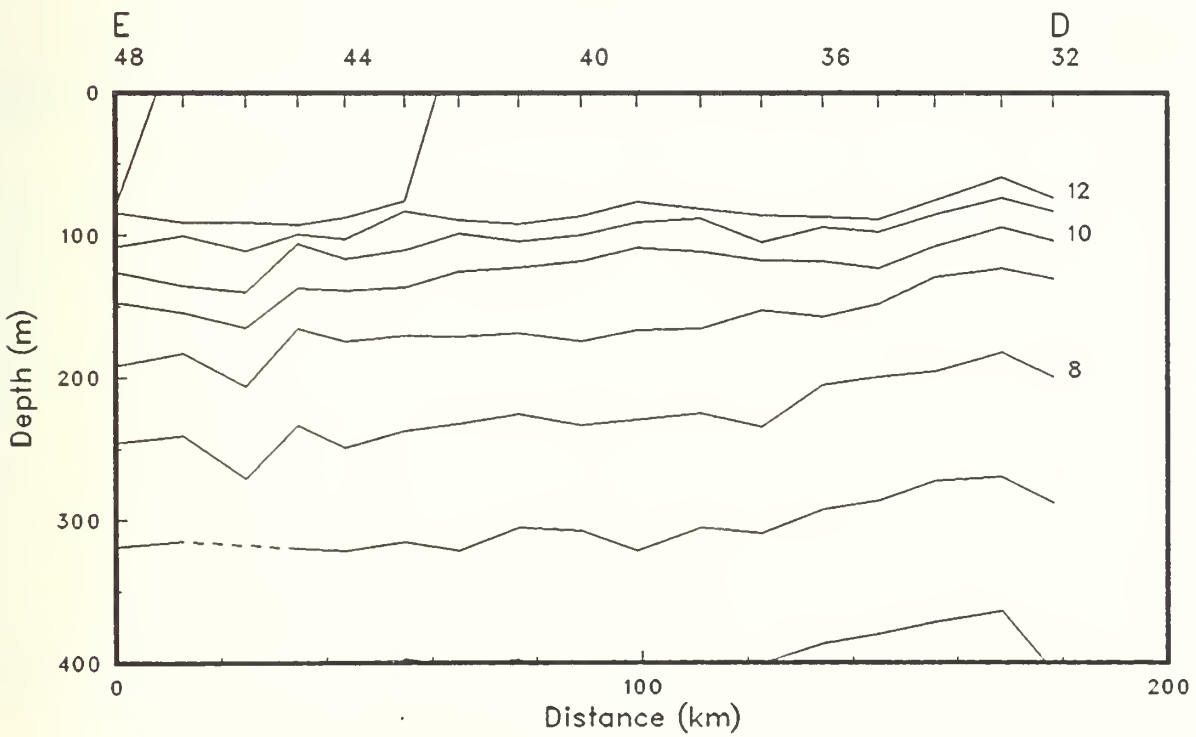


Figure 7(c).

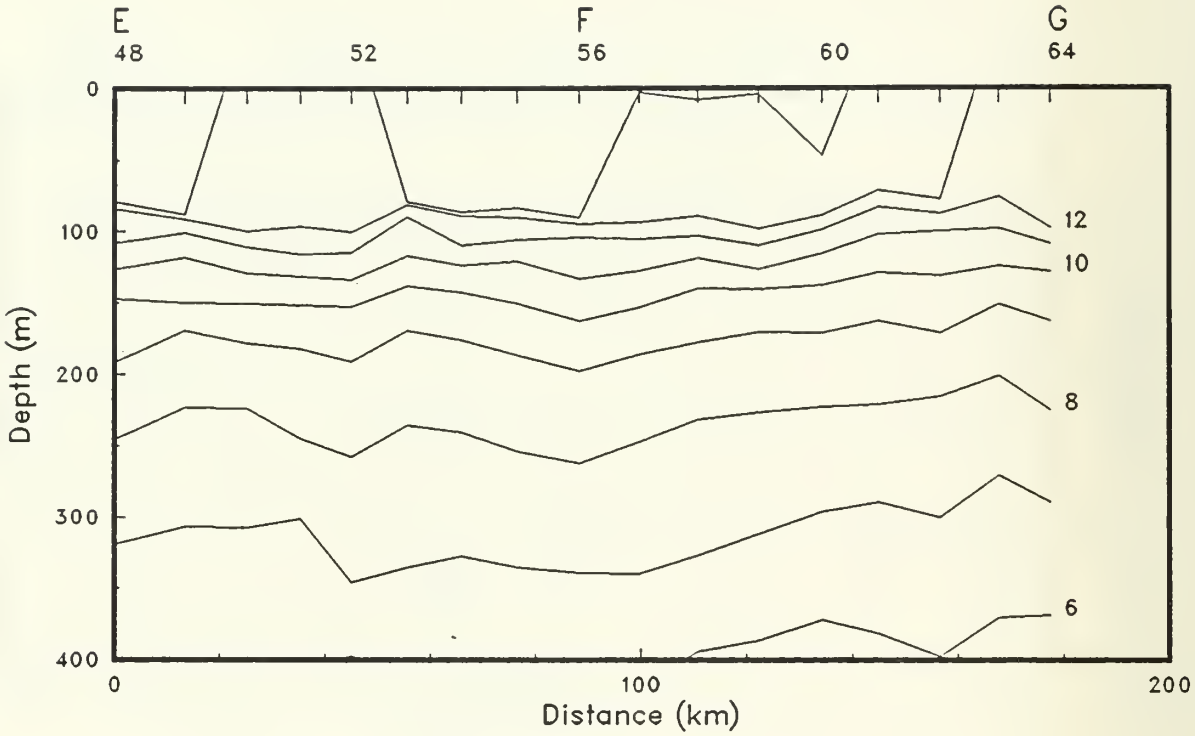


Figure 7(d).

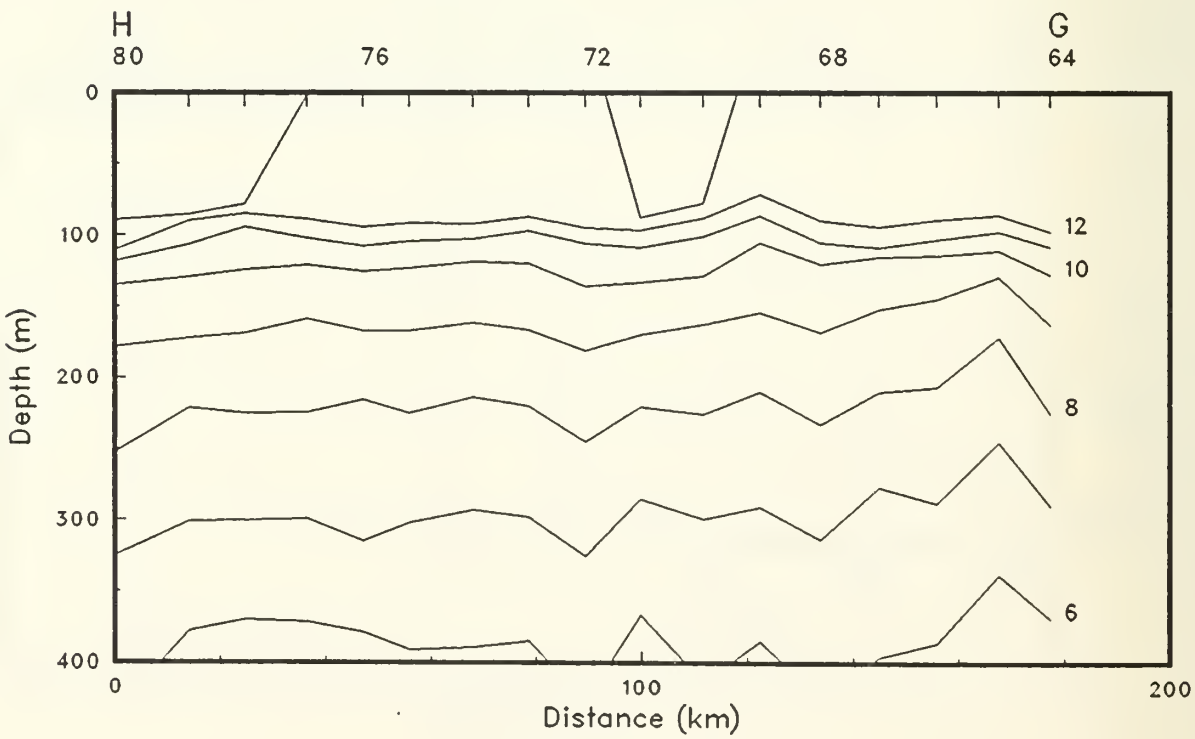


Figure 7(e).

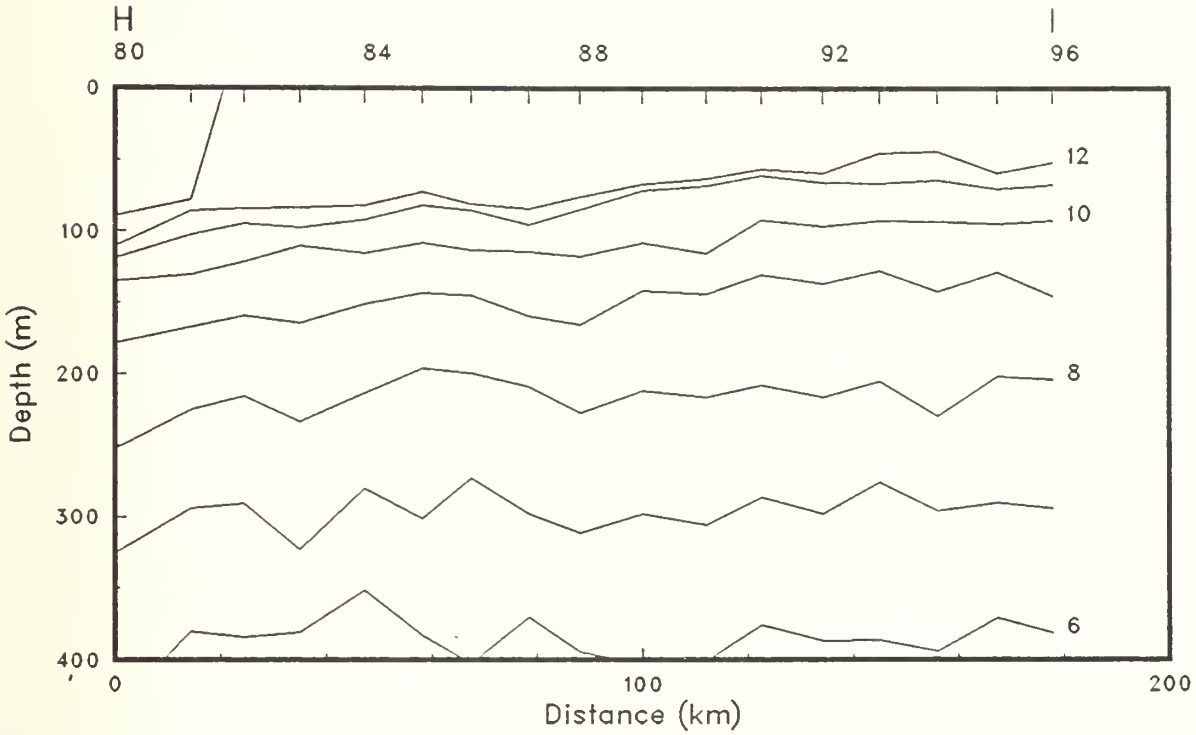


Figure 7(f).

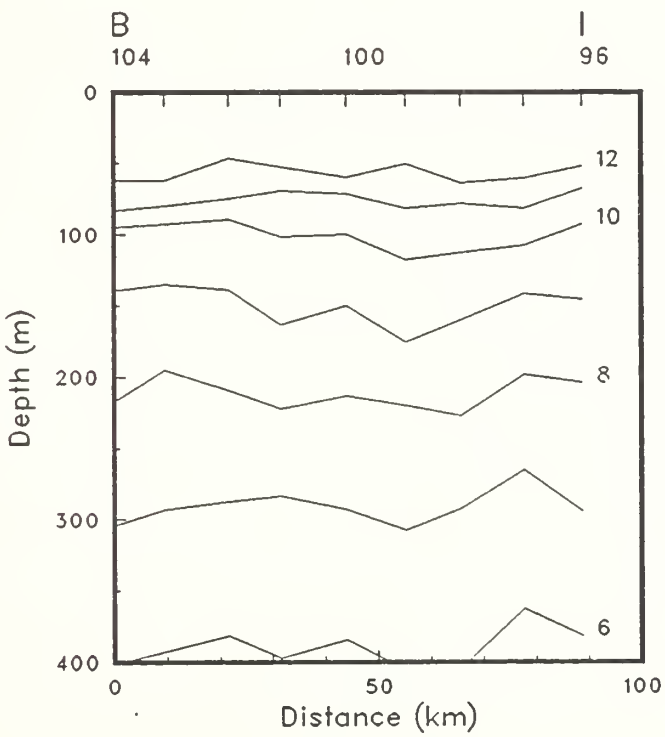


Figure 7(g).

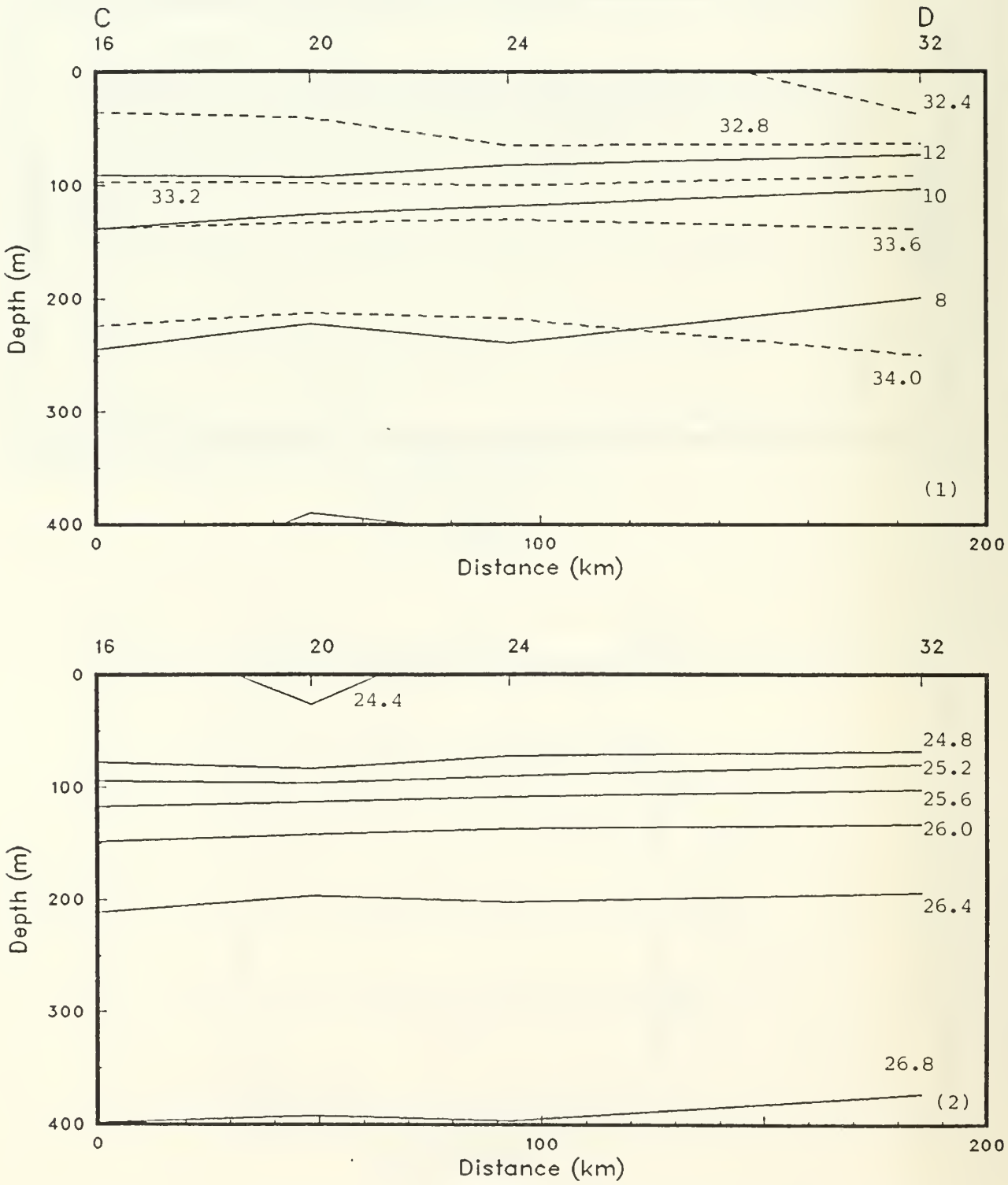


Figure 8(a): Isopleths of (1) temperature and salinity and (2) sigma-t, from the CTD's. (OPTOMA9).

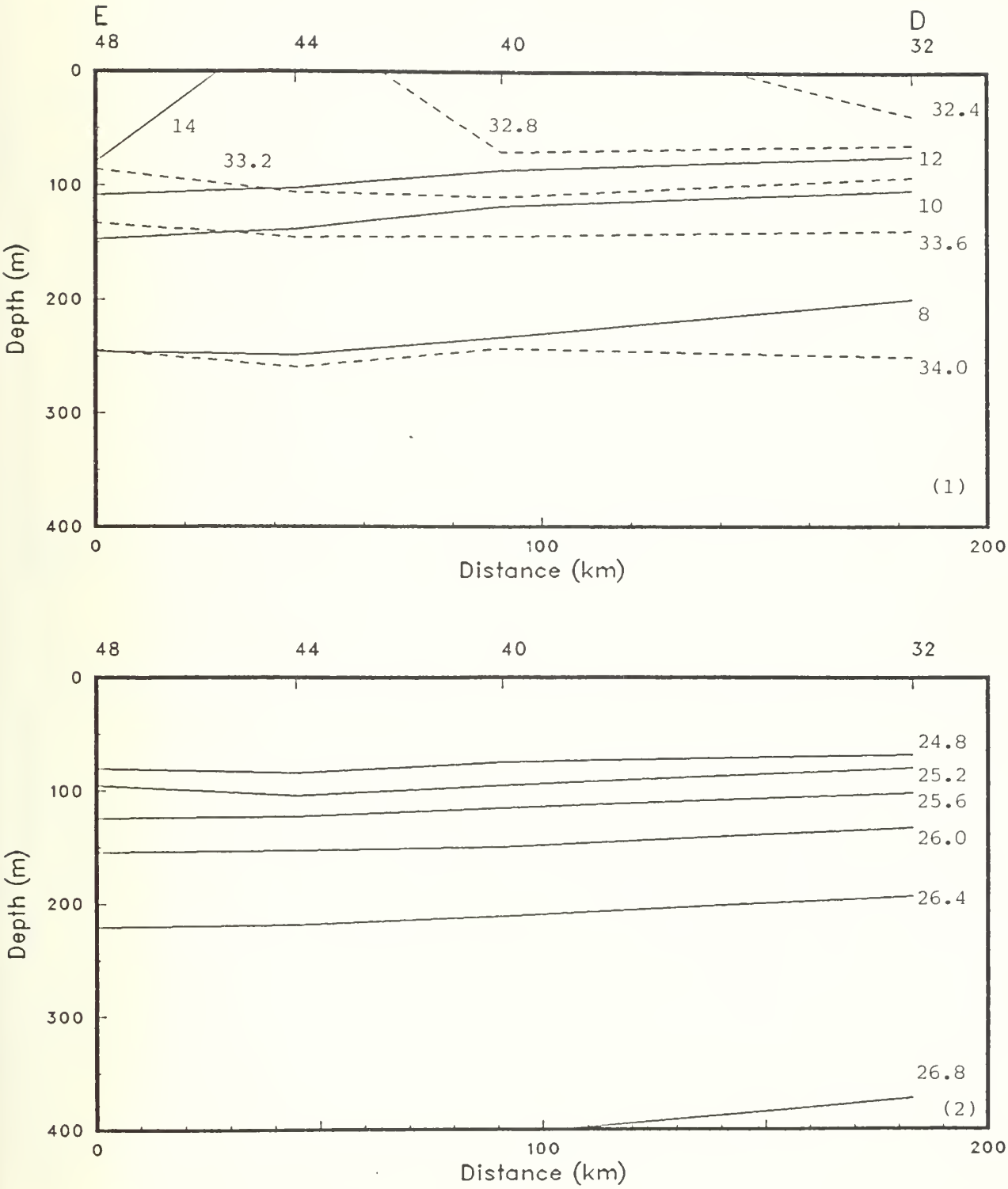

E
D
48
44
40
32
0
100
200
300
400
Depth (m)
14
33.2
32.8
32.4
12
10
33.6
8
34.0
(1)
0
100
200
Distance (km)
48
44
40
32
0
100
200
300
400
Depth (m)
24.8
25.2
25.6
26.0
26.4
26.8
(2)
0
100
200
Distance (km)

Figure 8(b).

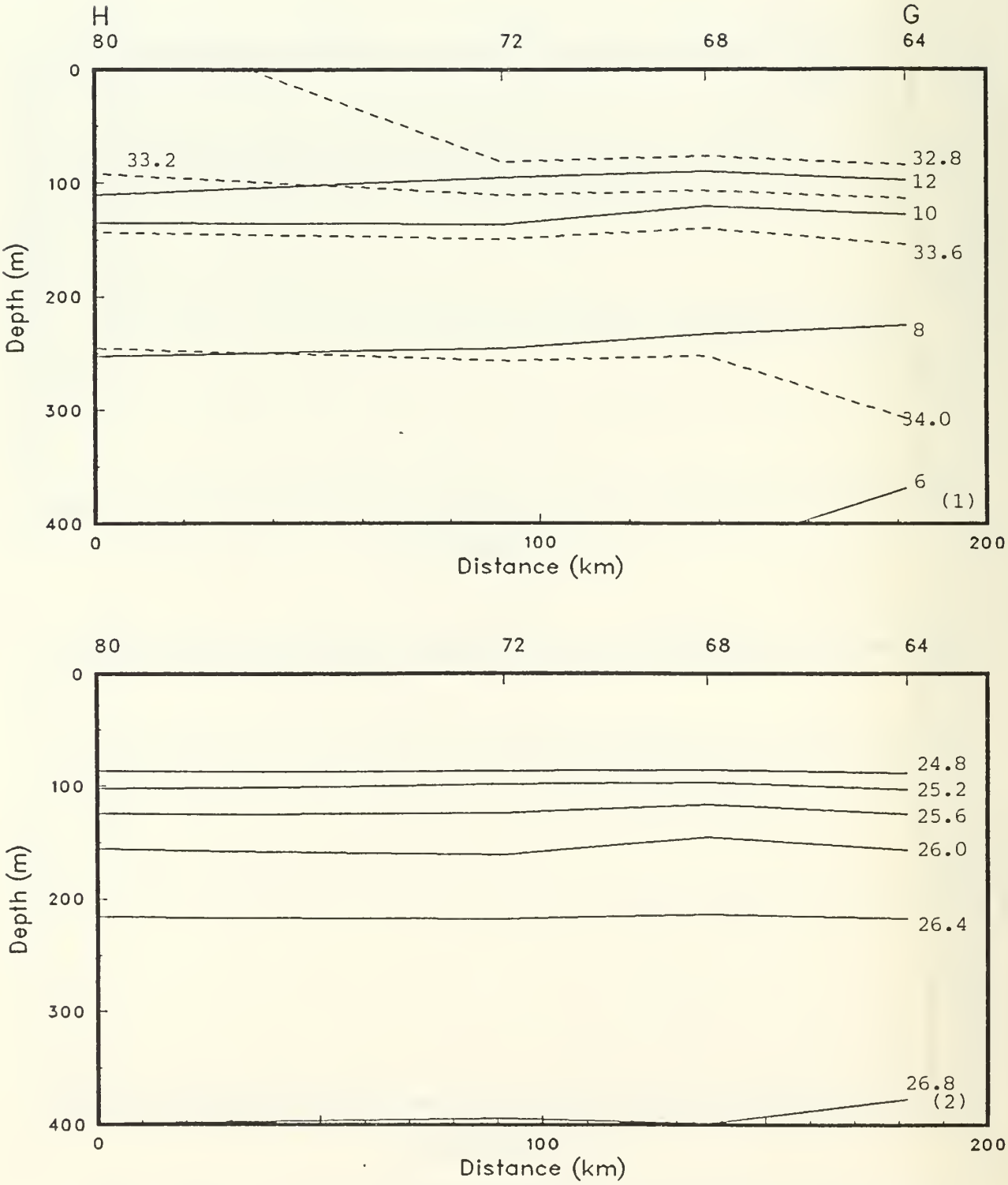

H
G
80
72
68
64
0
100
200
300
400
Depth (m)
33.2
32.8
12
10
33.6
8
34.0
6
(1)
0
100
200
Distance (km)
80
72
68
64
0
100
200
300
400
Depth (m)
24.8
25.2
25.6
26.0
26.4
26.8
(2)
0
100
200
Distance (km)

Figure 8(c).

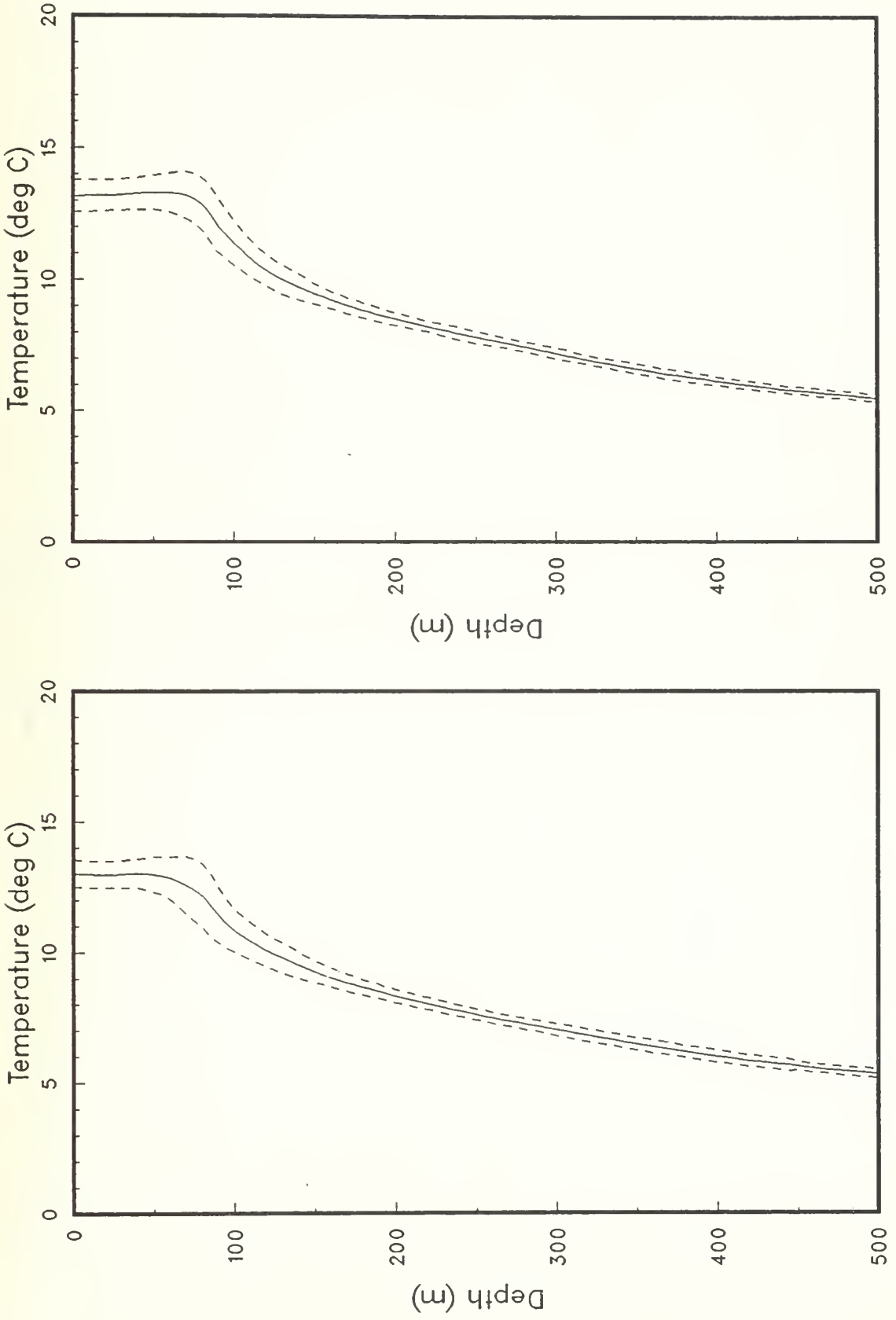


Figure 9: Mean temperature profiles from (a) XBT's and (b) CTD's, with + and - the standard deviations. (OPTOMA9).

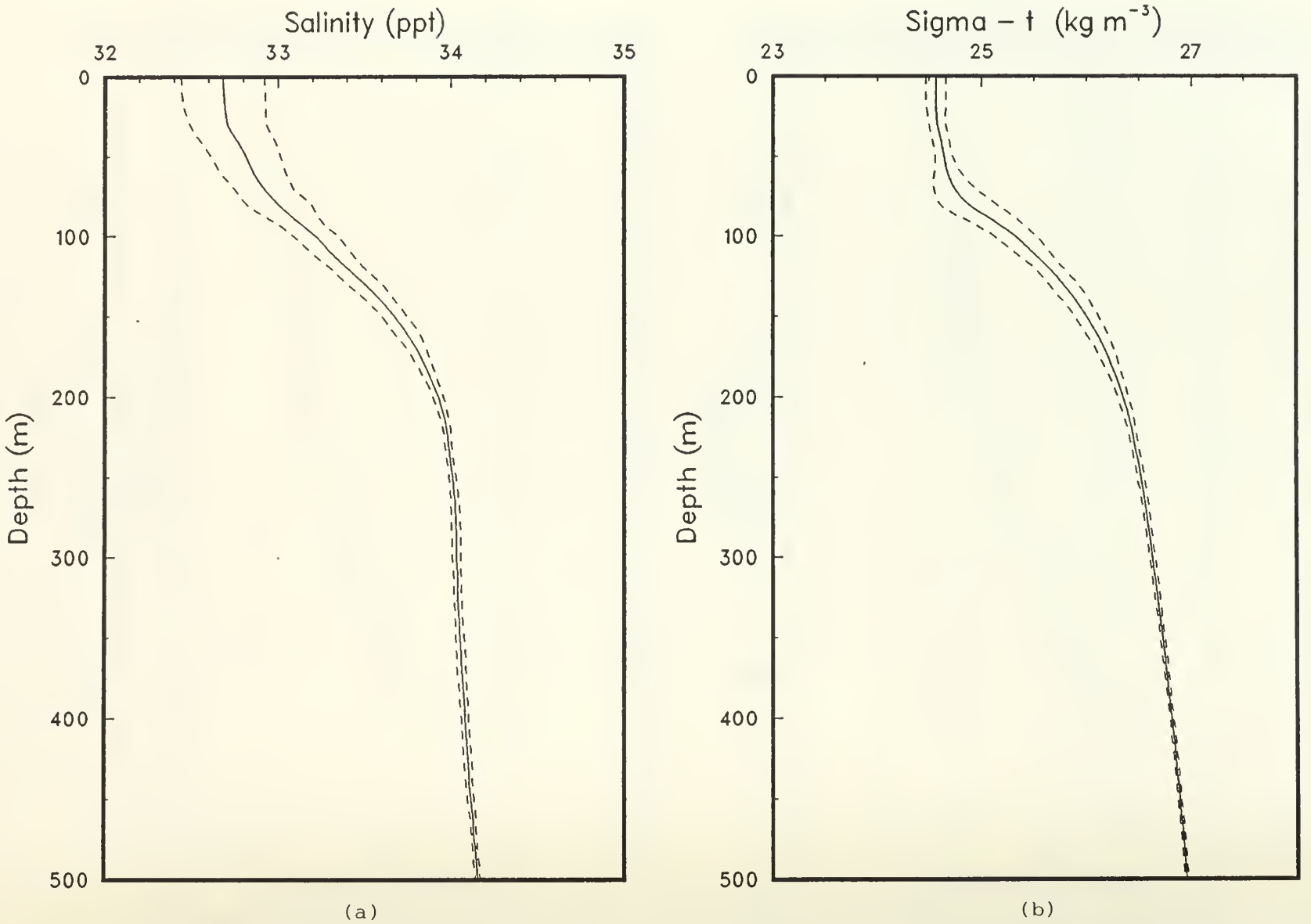


Figure 10: Mean profiles of (a) salinity and (b) sigma-t, with + and - the standard deviations, from the CTD's. (OPTOMA9).

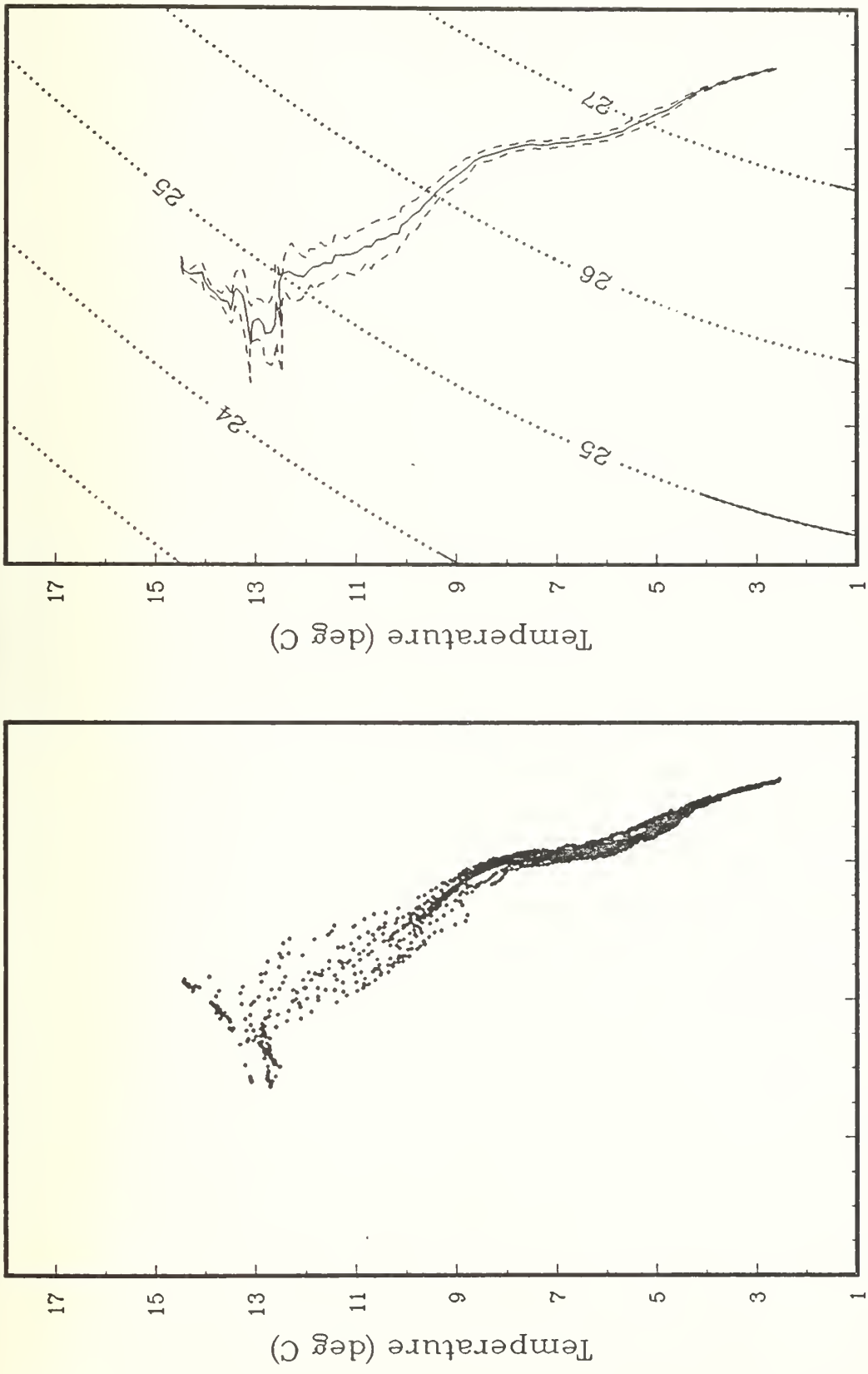


Figure 11: (a) T-S pairs and (b) mean T-S relation, with + and - the standard deviation, from the CTD's. Selected sigma-t contours are also shown. (OPTOMA9).

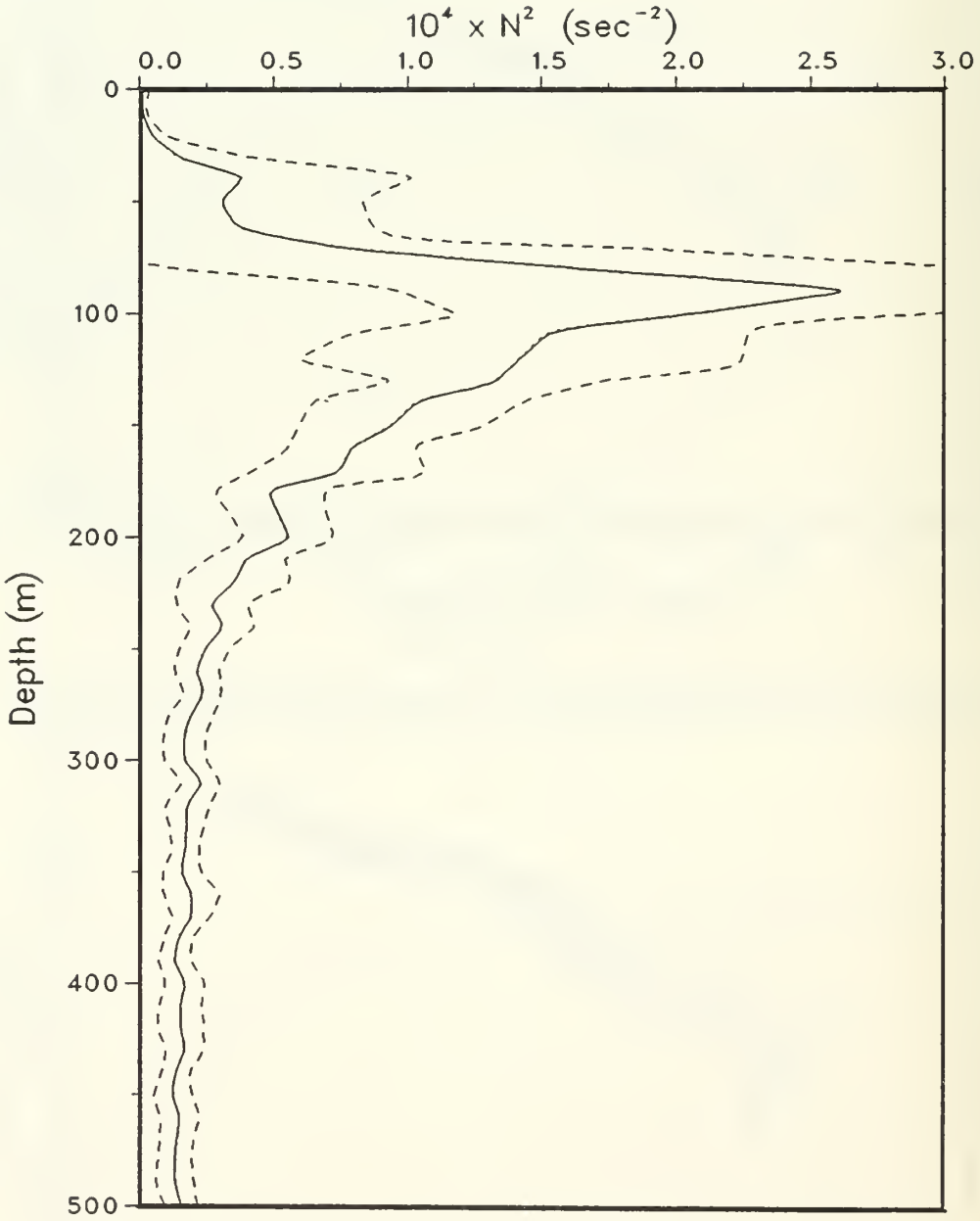


Figure 12: Mean N^2 profile, with + and - the standard deviation. (OPTOMA9).

SECTION 2
OPTOMASF
3 - 4 MARCH 1984

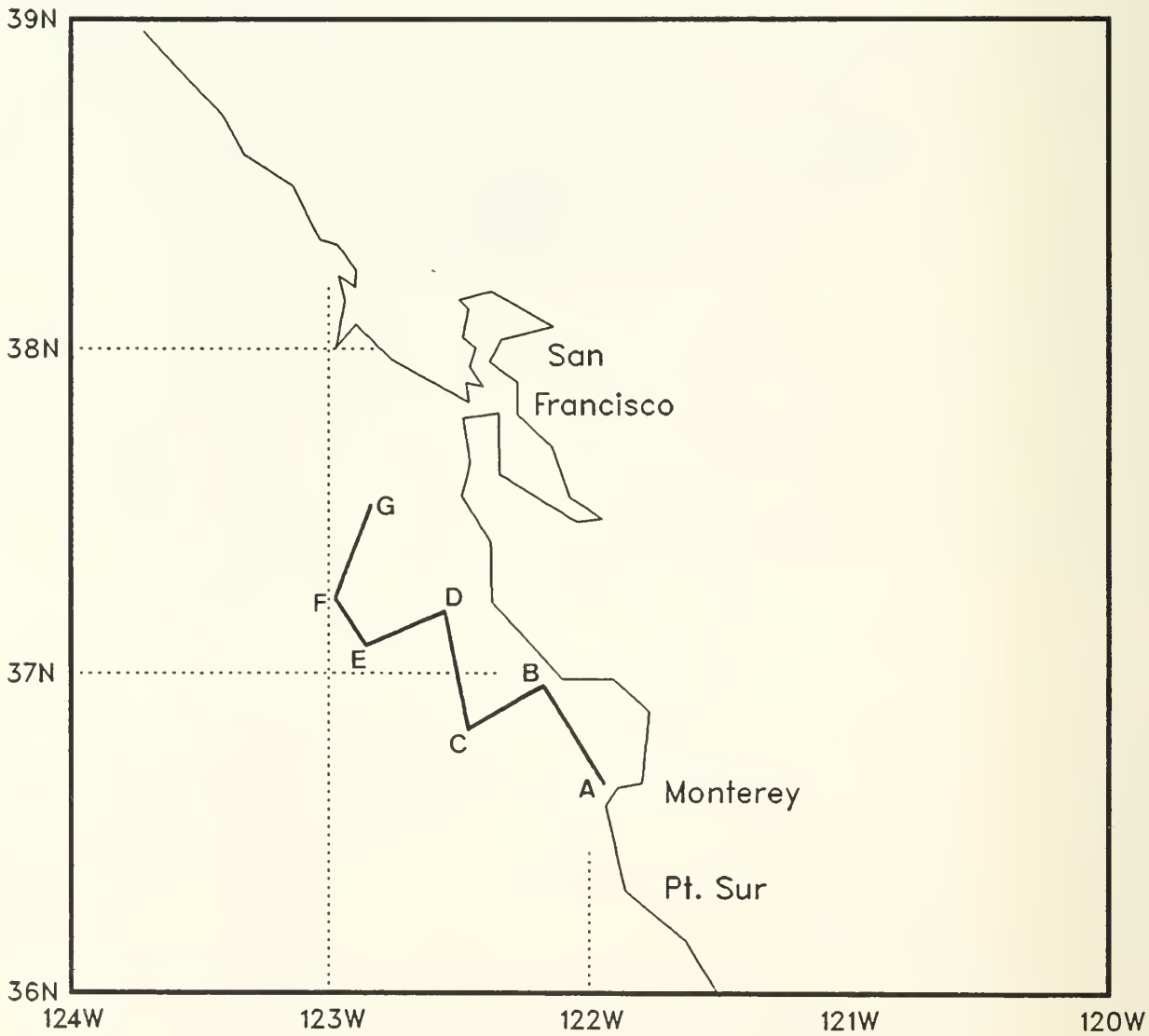


Figure 13: The cruise track for OPTOMASF.

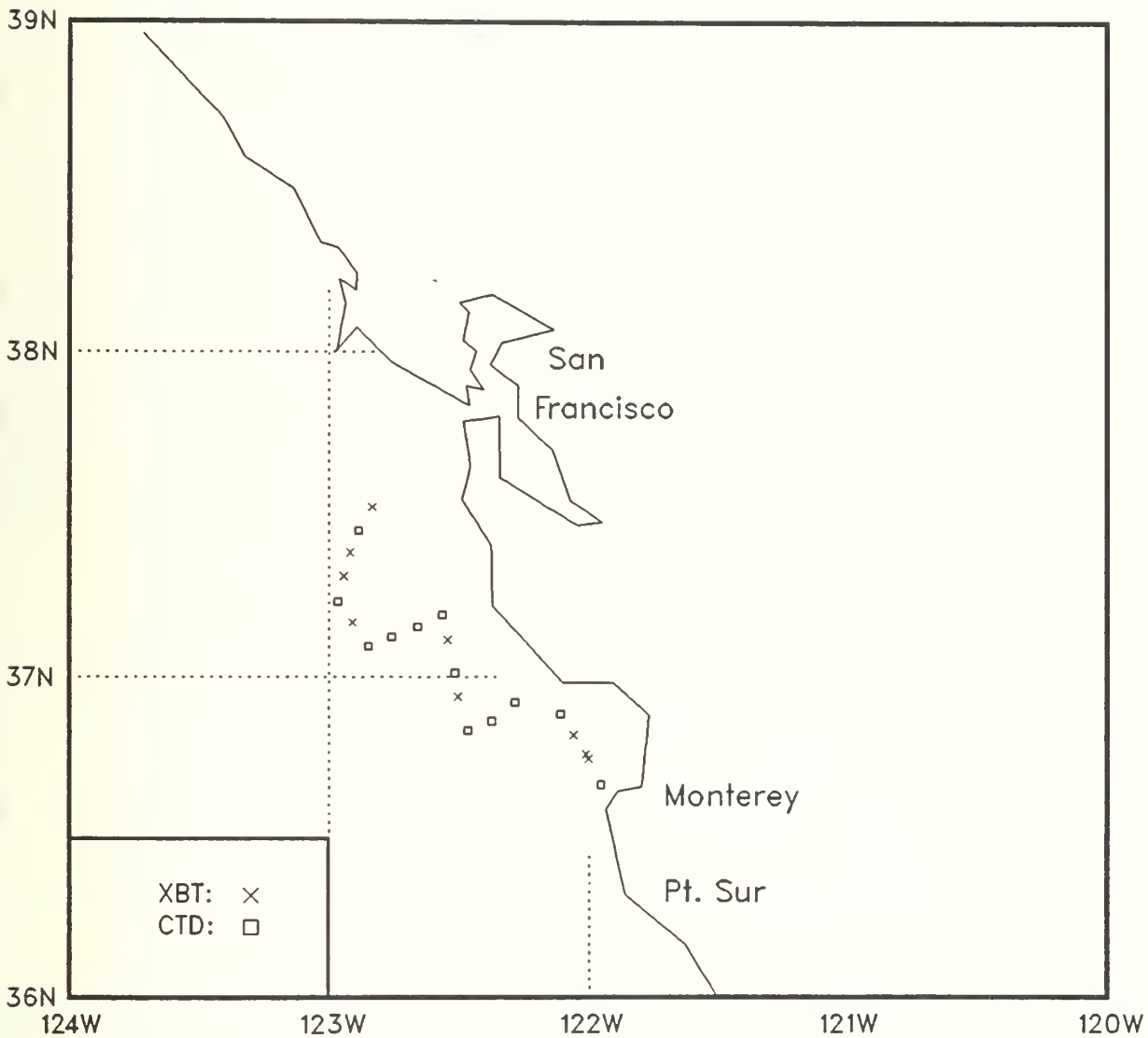


Figure 14: XBT and CTD station locations for OPTOMASF.

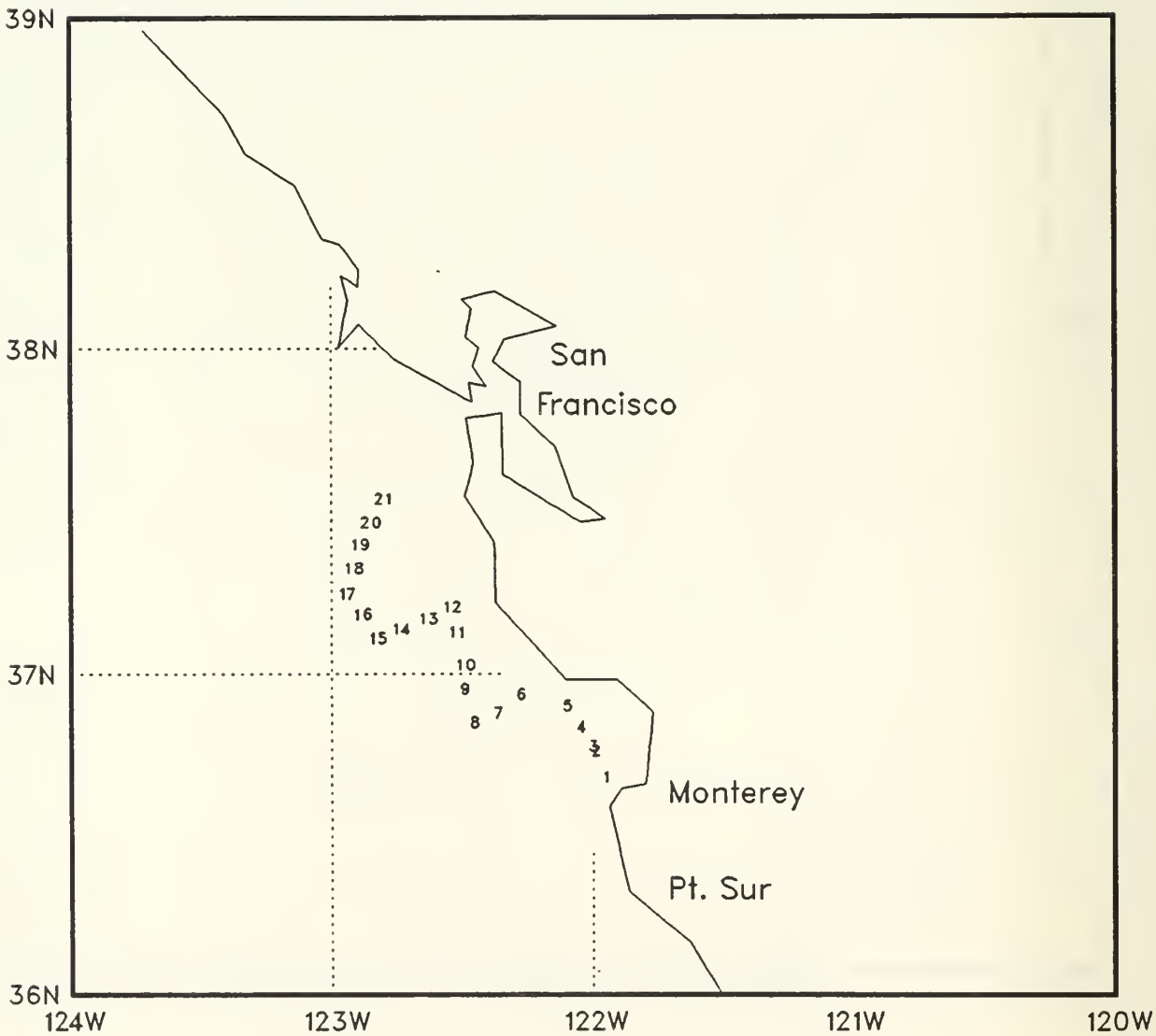


Figure 15: Station numbers for OPTOMASF.

Table 3: OPTOMASF Station Listing

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
1	CTD	84064	1059	36.40	121.57	13.0	33.22	13.1	32.79
2	XBT	84064	1140	36.45	122.00	12.4			
3	XBT	84064	1147	36.46	122.01	12.0			
4	XBT	84064	1217	36.49	122.04	12.7			
5	CTD	84064	1255	36.53	122.07	12.6	33.33	12.7	33.36
6	CTD	84064	1447	36.55	122.17	12.0	33.34	12.1	33.36
7	CTD	84064	1625	36.52	122.22	11.7	33.17	12.0	33.17
8	CTD	84064	1803	36.50	122.28	12.2	32.63	12.3	32.66
9	XBT	84064	1917	36.56	122.30	12.0			
10	CTD	84064	2007	37.01	122.31	12.2	32.68	12.2	32.69
11	XBT	84064	2058	37.07	122.33	12.1			
12	CTD	84064	2147	37.12	122.34	12.4	32.68	12.4	32.67
13	CTD	84064	2236	37.09	122.39	12.1	32.89	12.1	32.89
14	CTD	84064	2336	37.07	122.46	12.7	32.71	12.7	32.72
15	CTD	84065	40	37.06	122.51	12.9	32.79	12.9	32.82
16	XBT	84065	124	37.10	122.55	12.8			
17	CTD	84065	225	37.14	122.58	13.0	32.85	13.0	32.86
18	XBT	84065	305	37.19	122.57	12.7			
19	XBT	84065	338	37.23	122.55	12.6			
20	CTD	84065	424	37.27	122.53	11.9	32.84	12.0	32.79
21	XBT	84065	500	37.32	122.50	12.0			

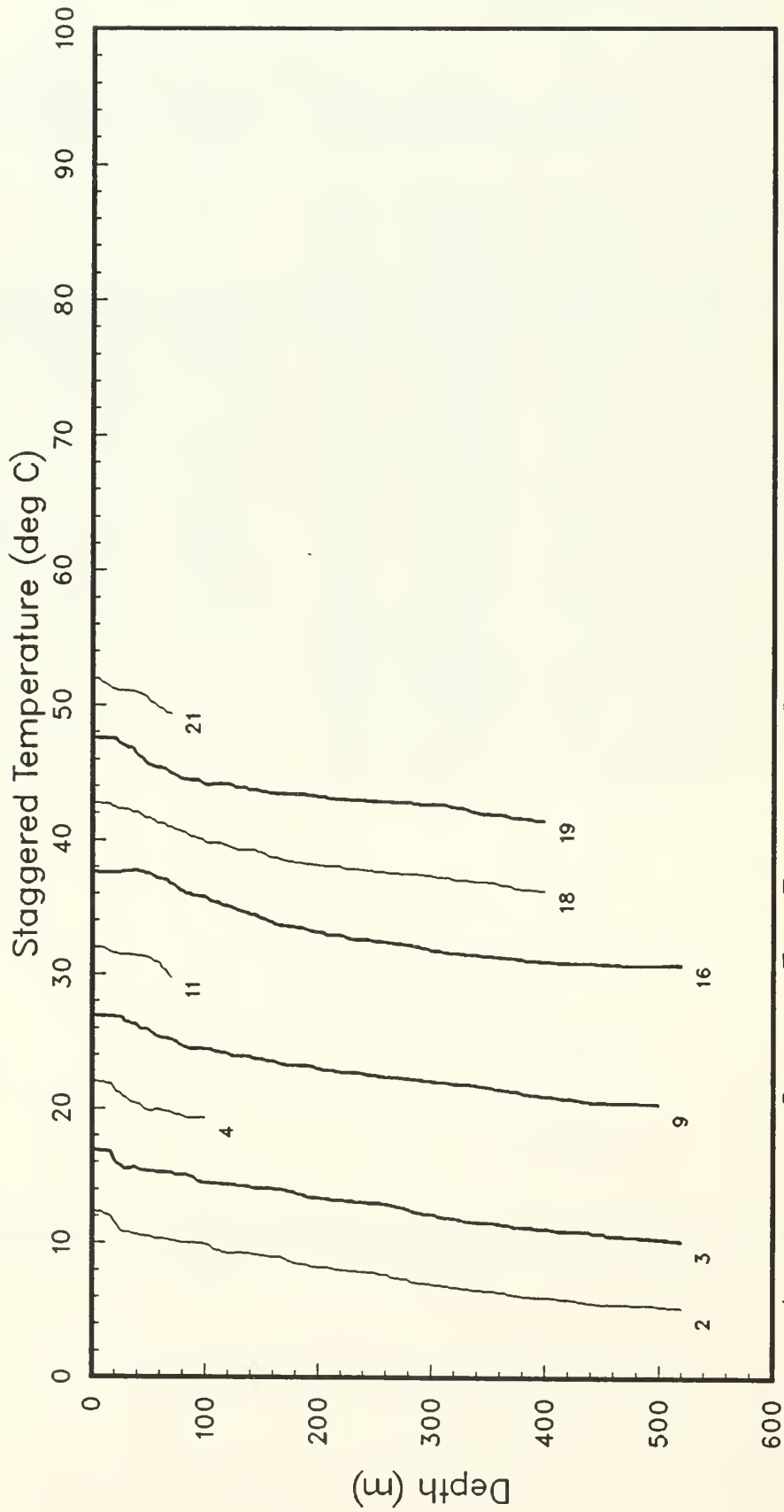


Figure 16: XBT temperature profiles, staggered by multiples of 5C. (OPTOMASF).

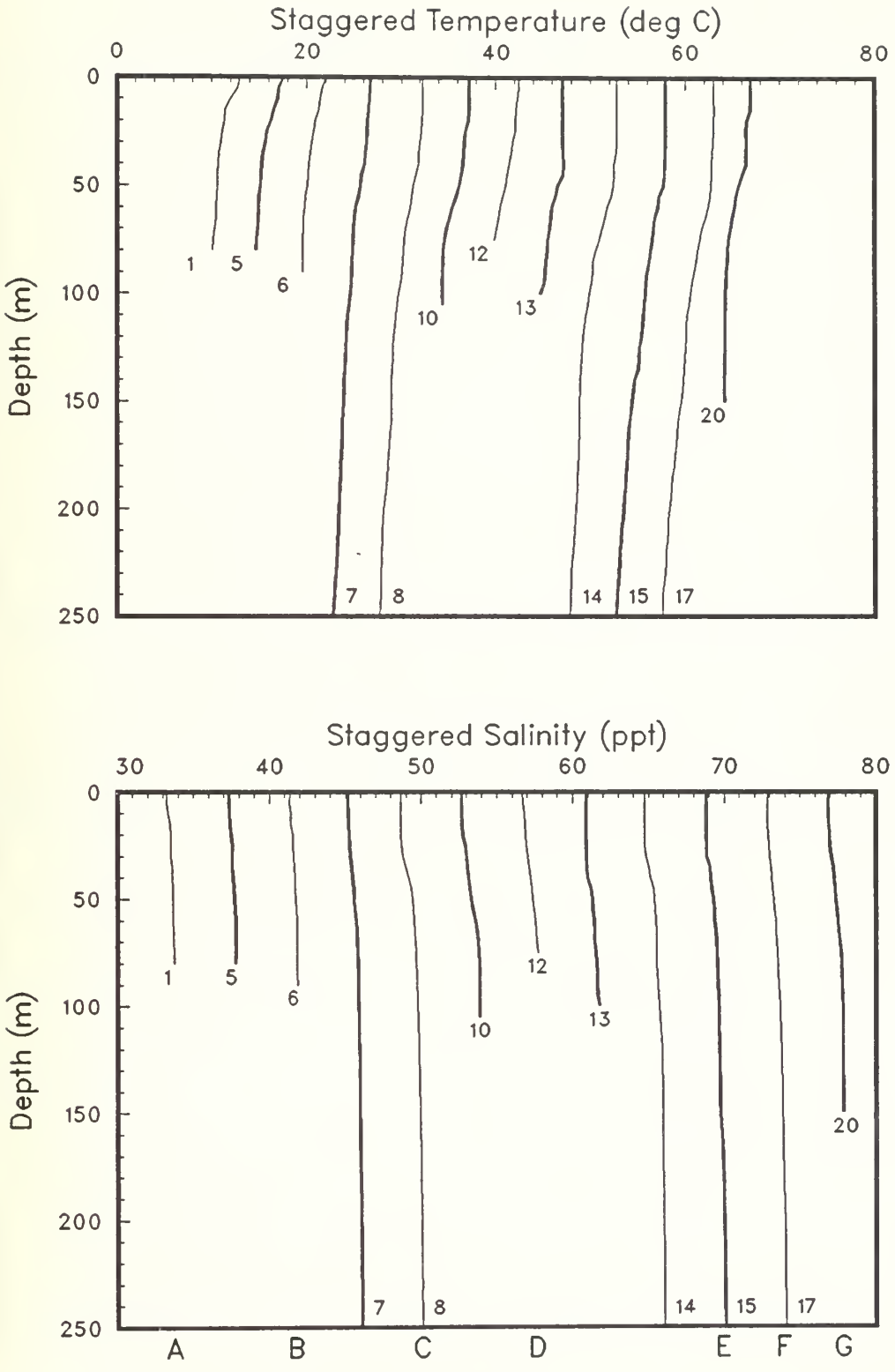


Figure 17: CTD temperature profiles, staggered by multiples of 5C, and salinity profiles, staggered by multiples of 4 ppt. (OPTOMASF).

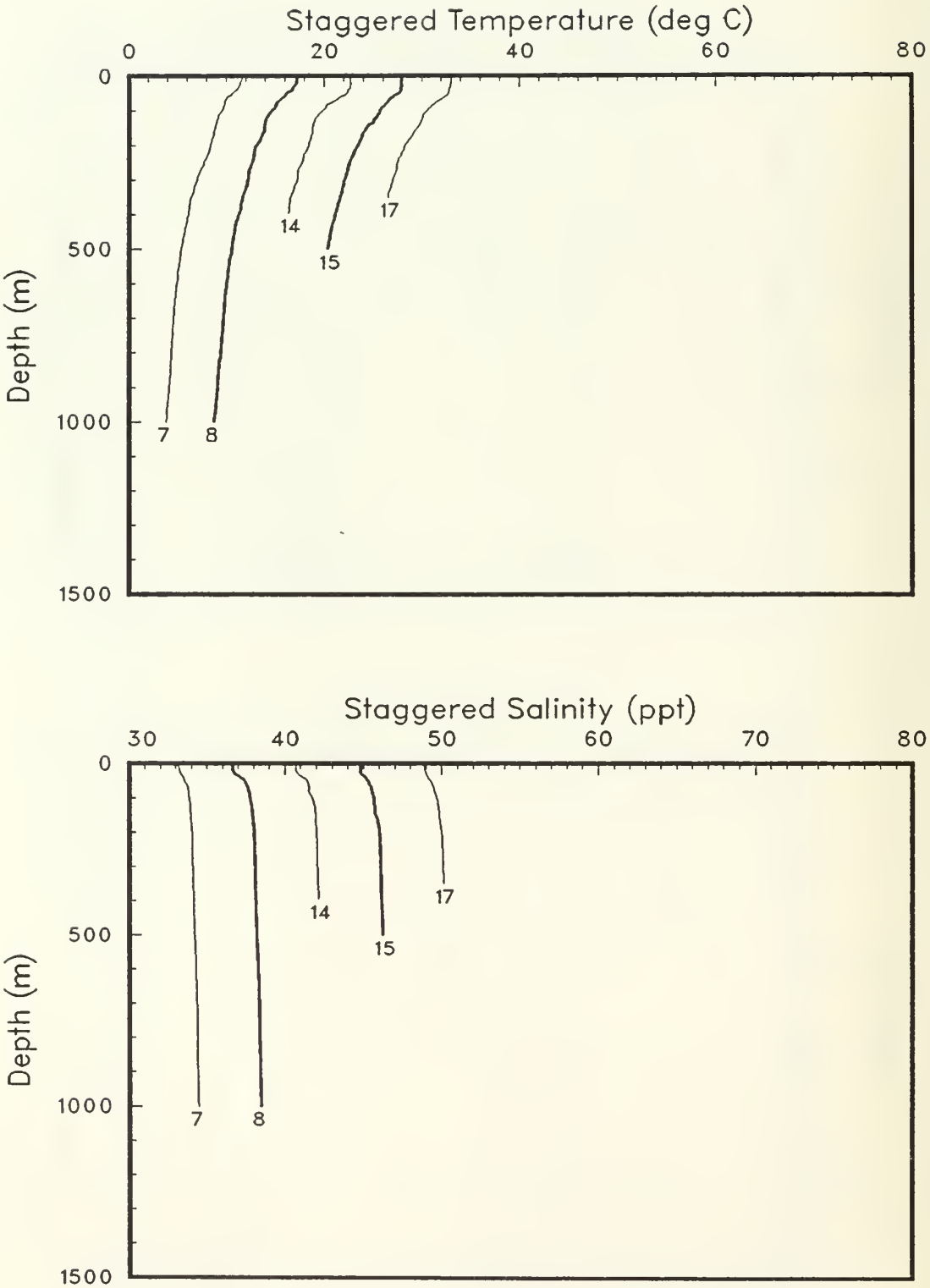


Figure 18: Profiles of temperature and salinity from CTD casts deeper than 250m. (OPTOMASF).

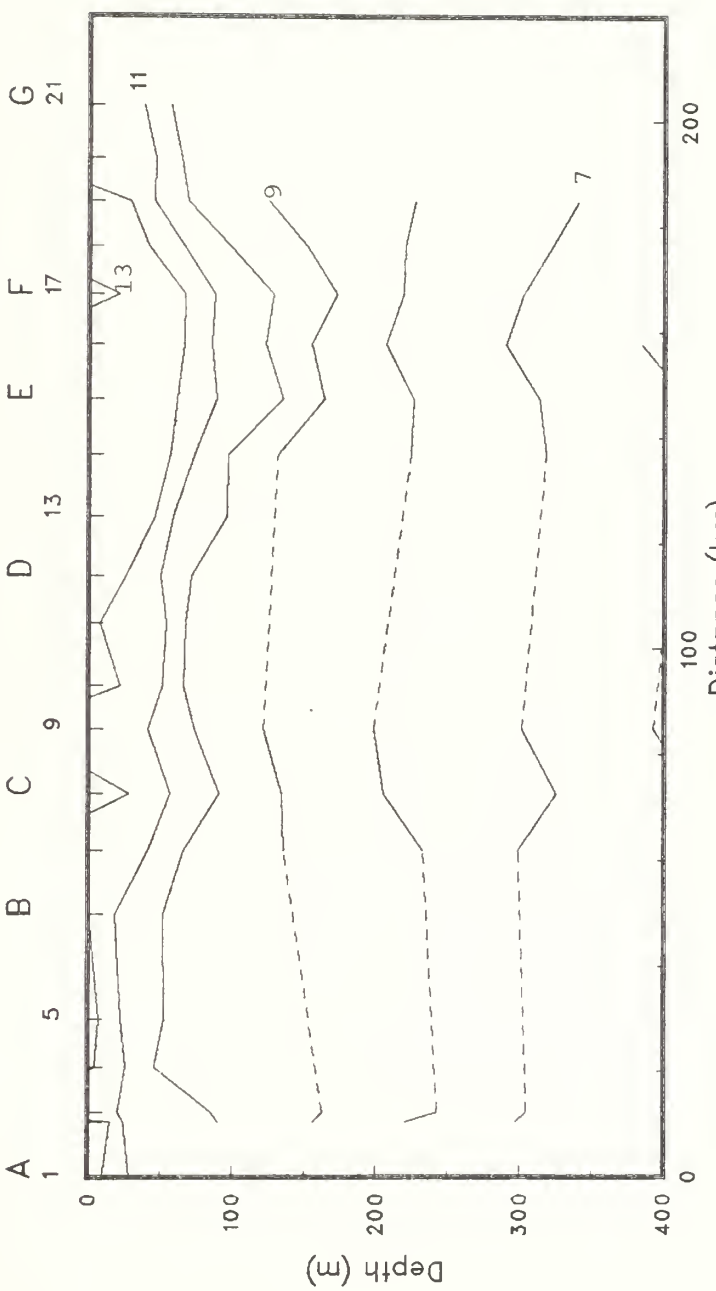


Figure 19: Along-track isotherms. Tick marks along the upper horizontal axis show station positions. Some station numbers are given. Dashed lines are used if the cast was too shallow. (OPTOMASF).

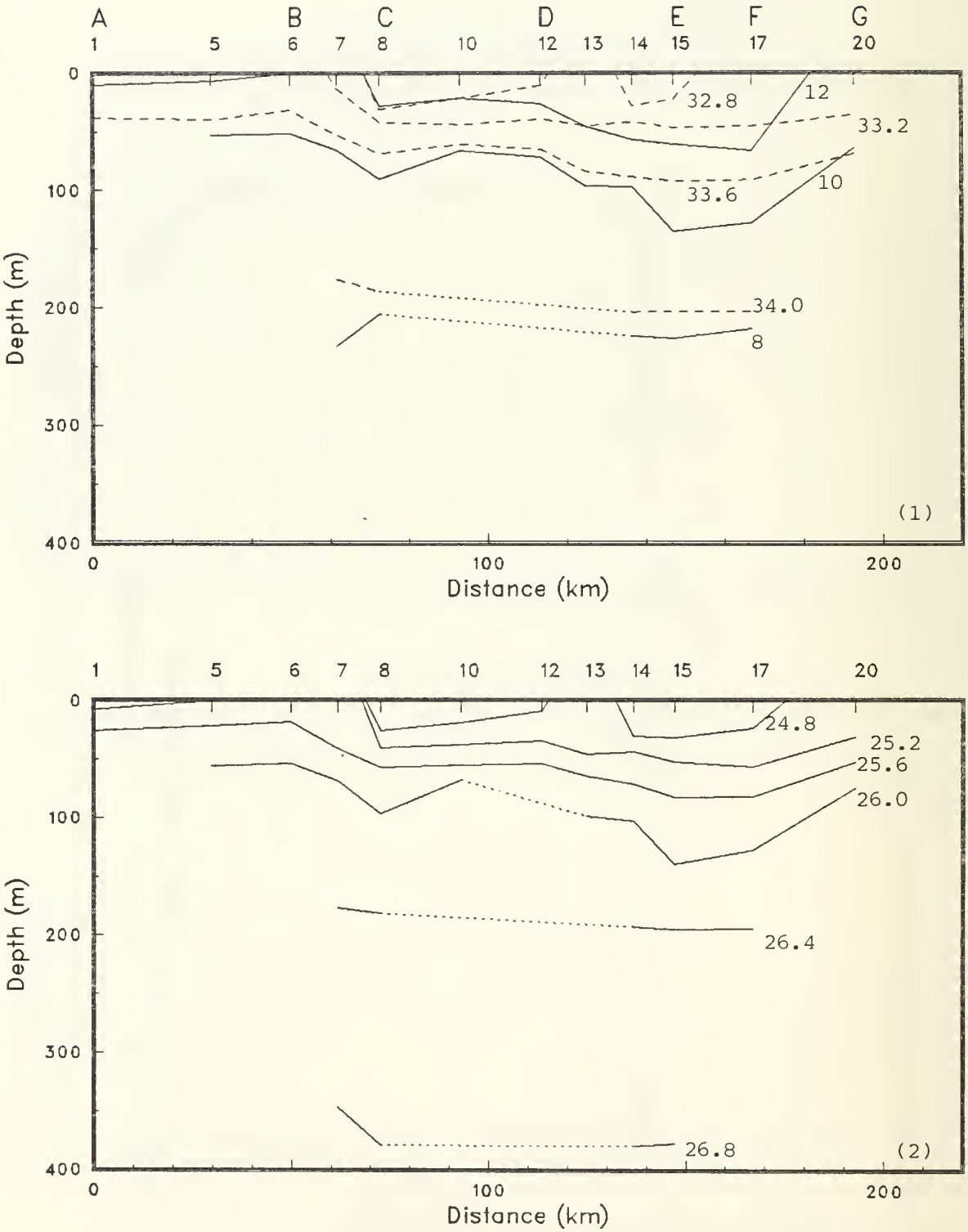


Figure 20: Isopleths of (1) temperature and salinity and (2) sigma-t, from the CTD's. Dotted lines are used if the cast was too shallow. (OPTOMASF).

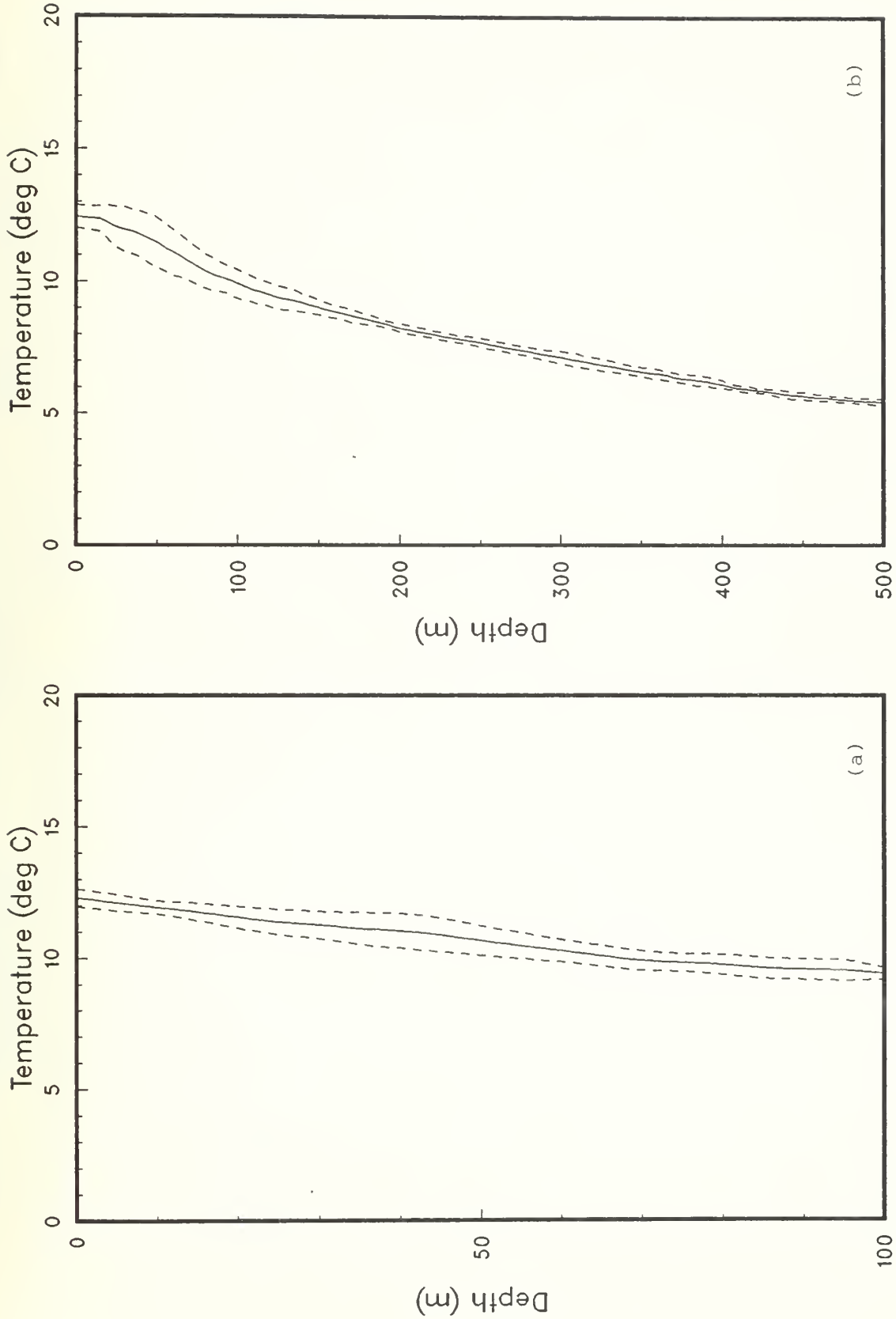


Figure 21: Mean temperature profiles, with + and - the standard deviations, from (a) casts shallower than 150m and (b) casts deeper than 300m. (OPTOMASF).

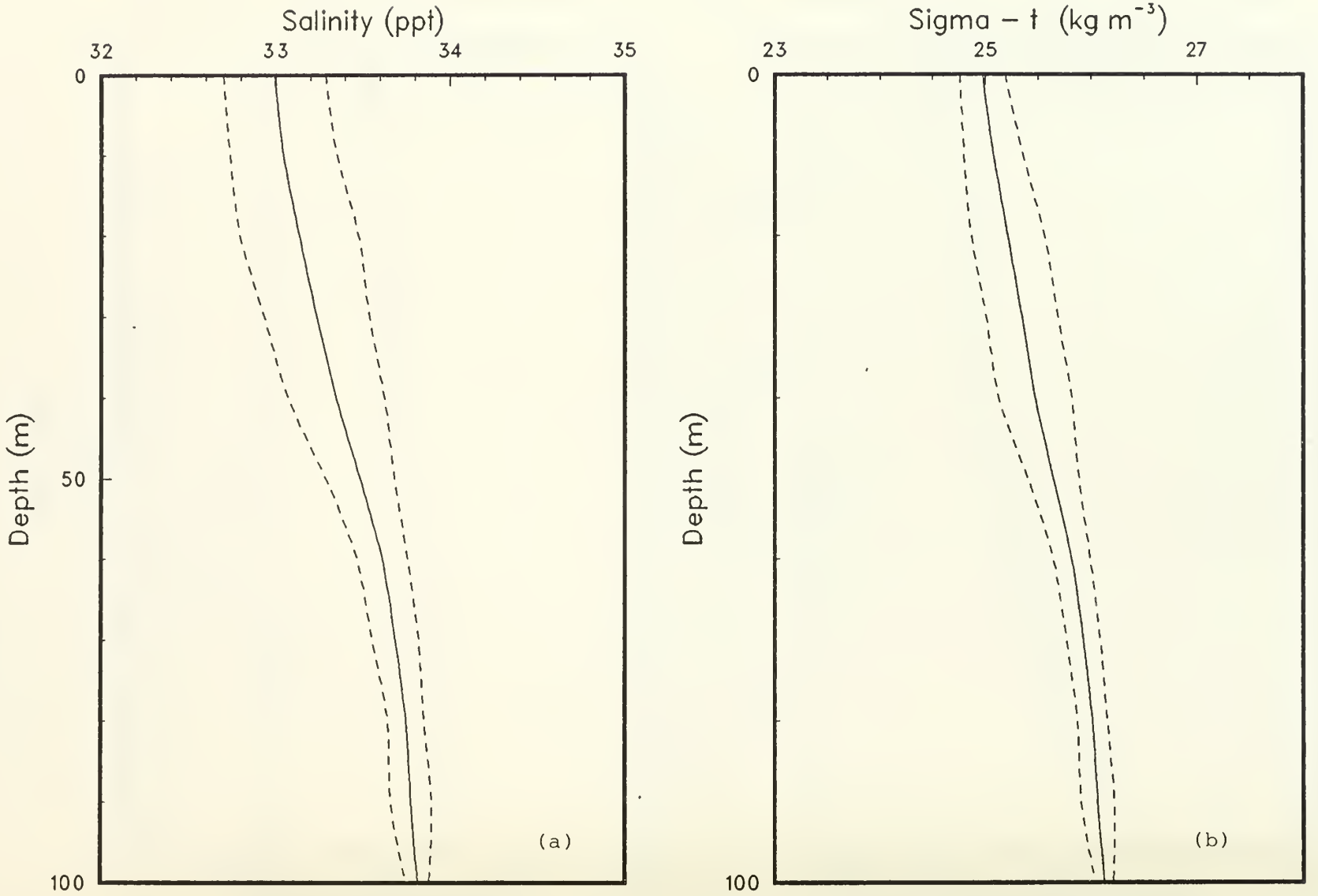


Figure 22: Mean profiles of (a) salinity and (b) sigma-t, with + and - the standard deviations, from the CTD casts shallower than 150m. (OPTOMASF).

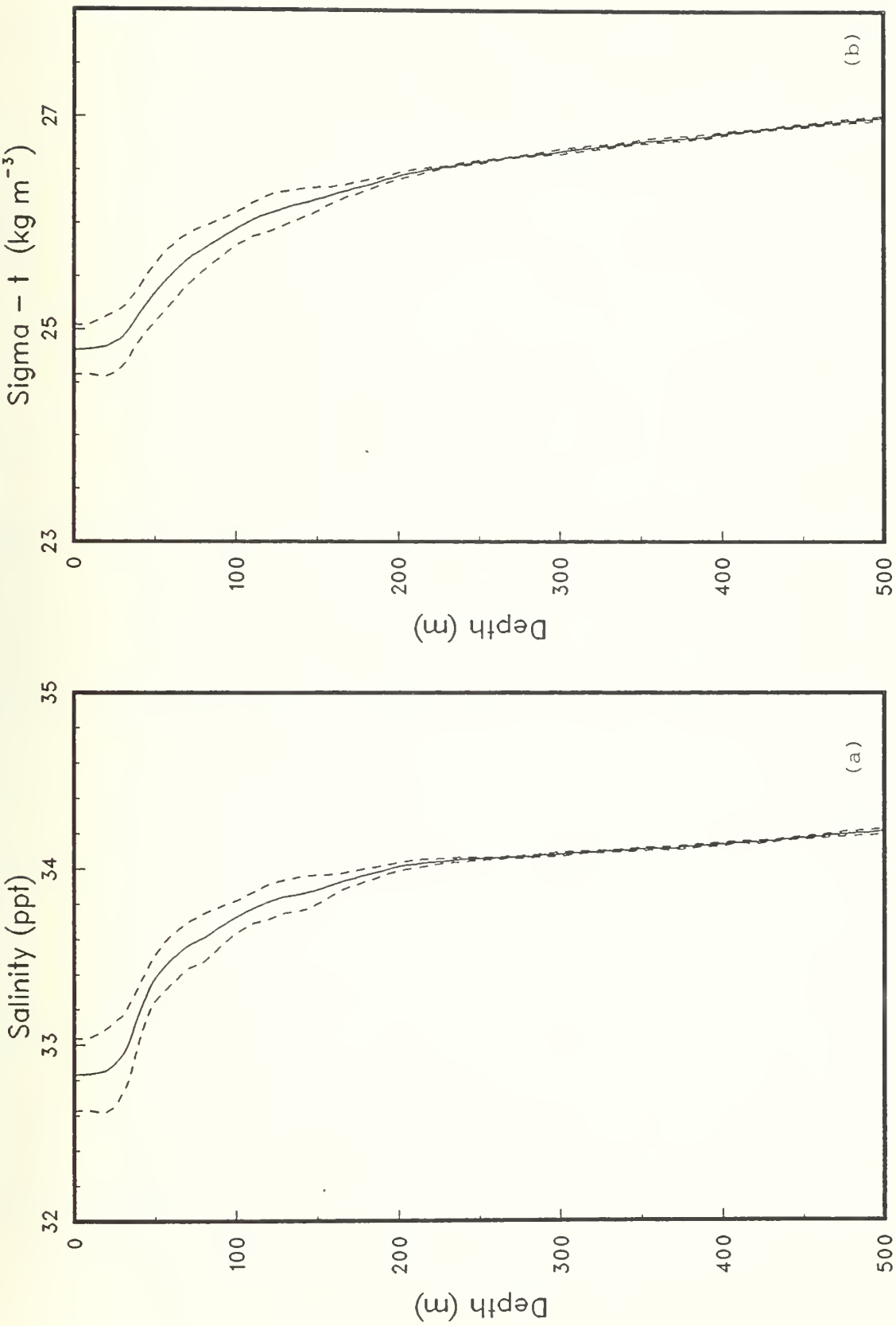


Figure 23: Mean profiles of (a) salinity and (b) sigma-t, with + and - the standard deviations, from the CTD casts deeper than 300m. (OPTOMASF).

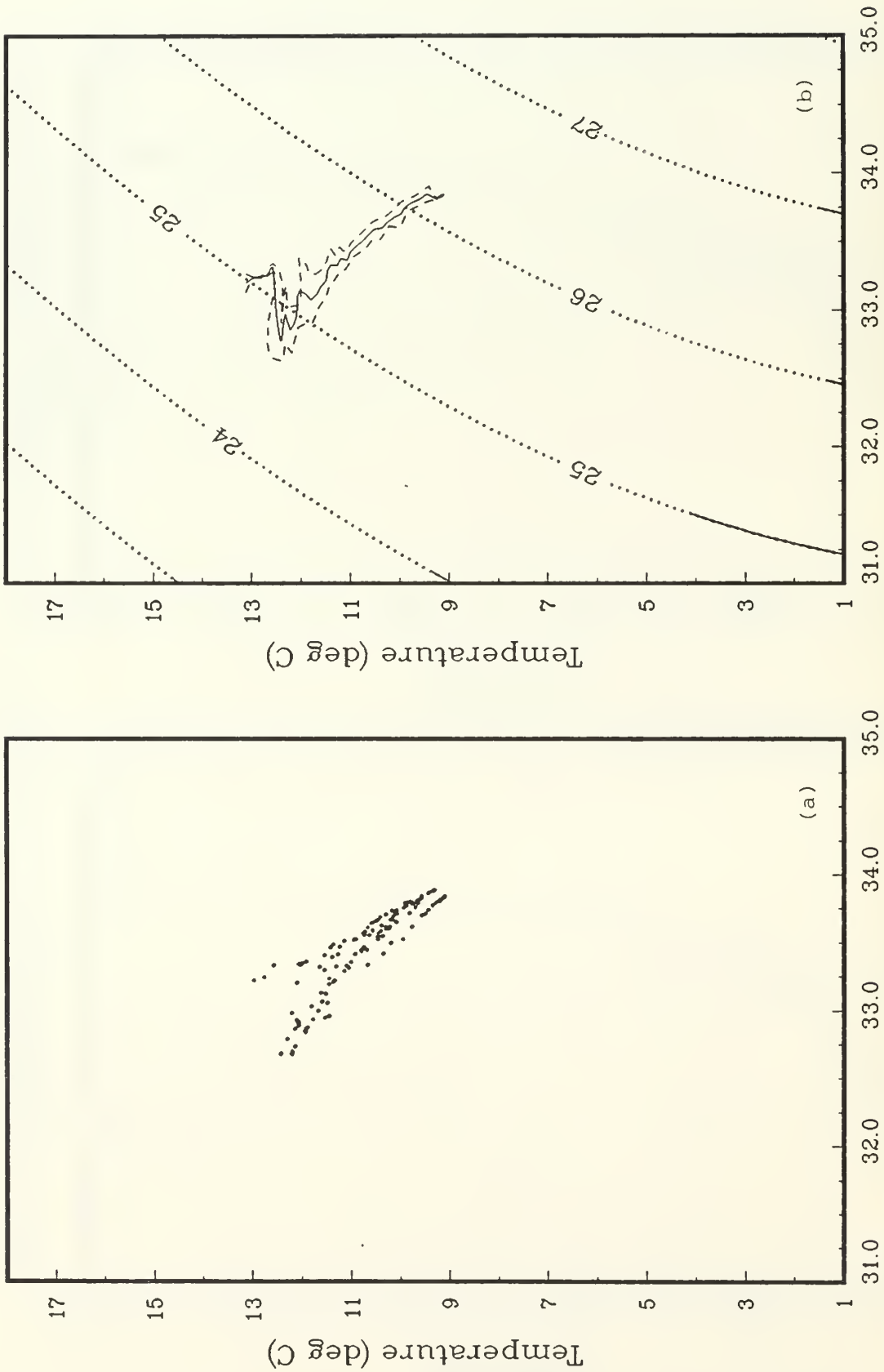


Figure 24: (a) T-S pairs and (b) mean T-S relation, with + and - the standard deviation, from the CTD'S shallower than 150m. Selected sigma-t contours are also shown. (OPTOMASF).

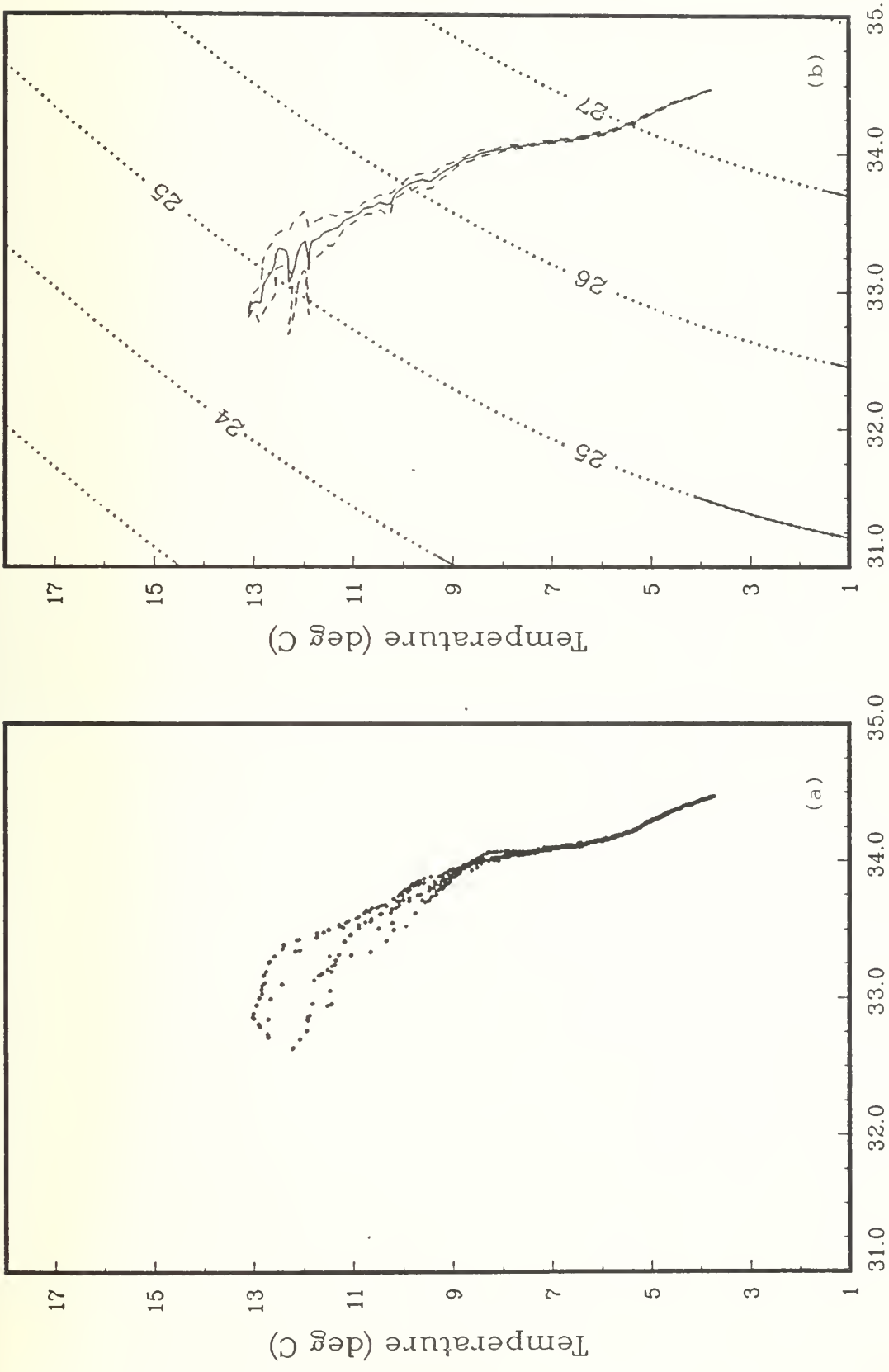


Figure 25: (a) T-S pairs and (b) mean T-S relation, with + and - the standard deviation, from the CTD's deeper than 300m. Selected sigma-t contours are also shown. (OPTOMASF).

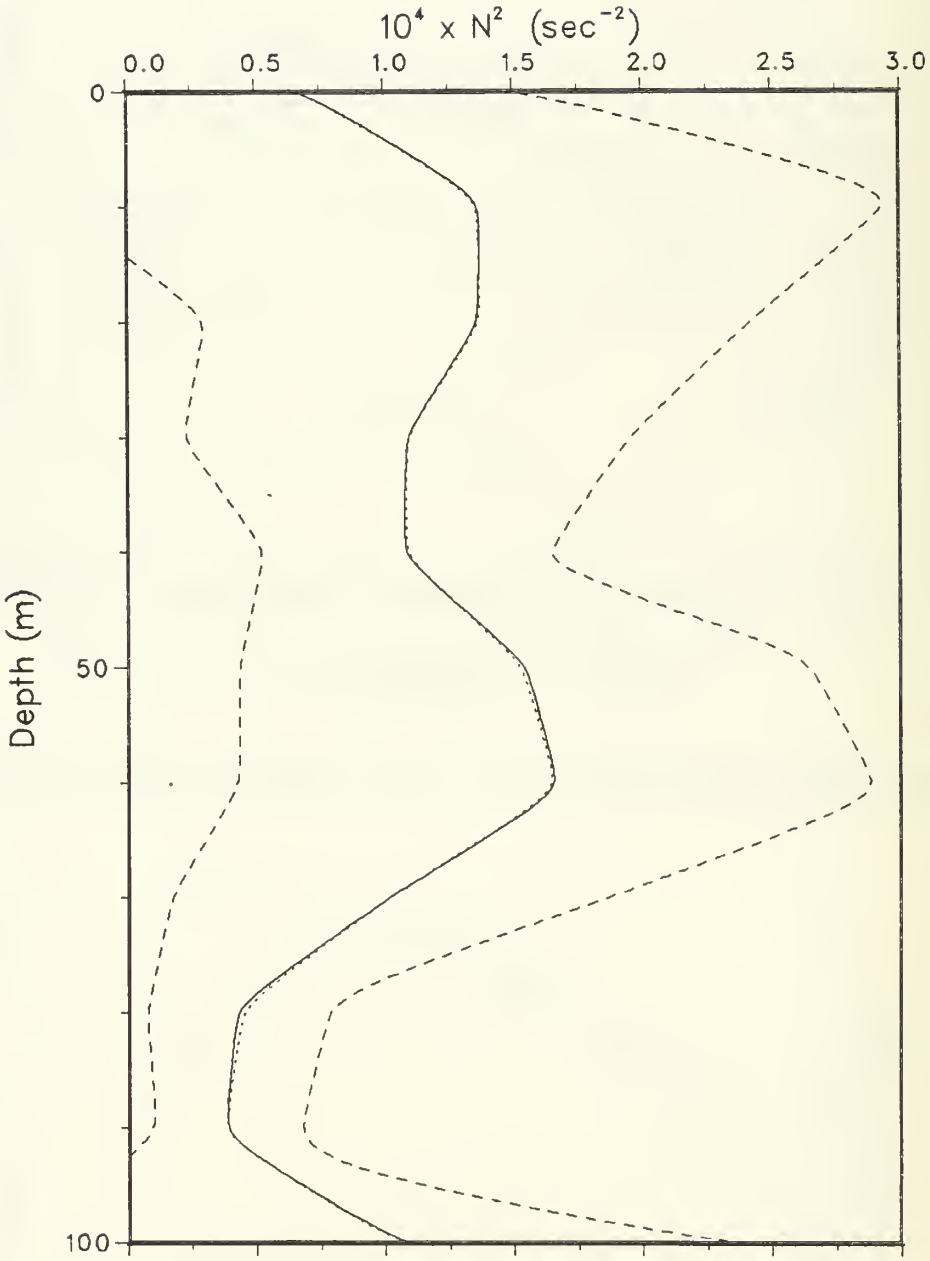


Figure 26: Mean N^2 profile (——), with + and - the standard deviation (----) from the CTD's shallower than 150m. The N^2 profile from $\overline{T(z)}$ and $\overline{S(z)}$ (••••) is also shown. (OPTOMASF).

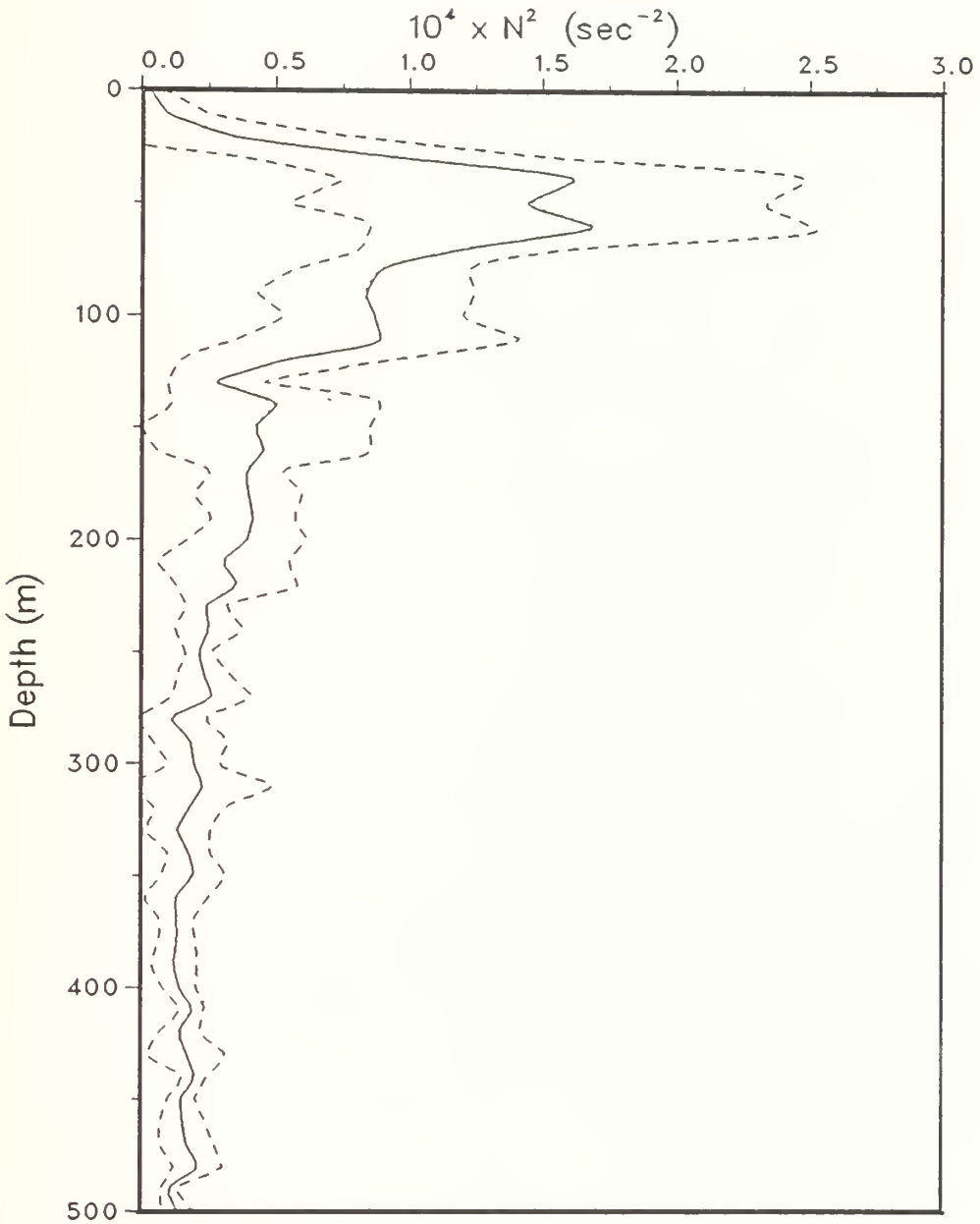


Figure 27: Mean N^2 profile (——), with + and - the standard deviation (----), from the CTD's deeper than 300m. The N^2 profile from $\overline{T(z)}$ and $\overline{S(z)}$ is also shown (••••). (OPTOMASF).

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 3
OPTOMA10
23 - 24 APRIL 1984

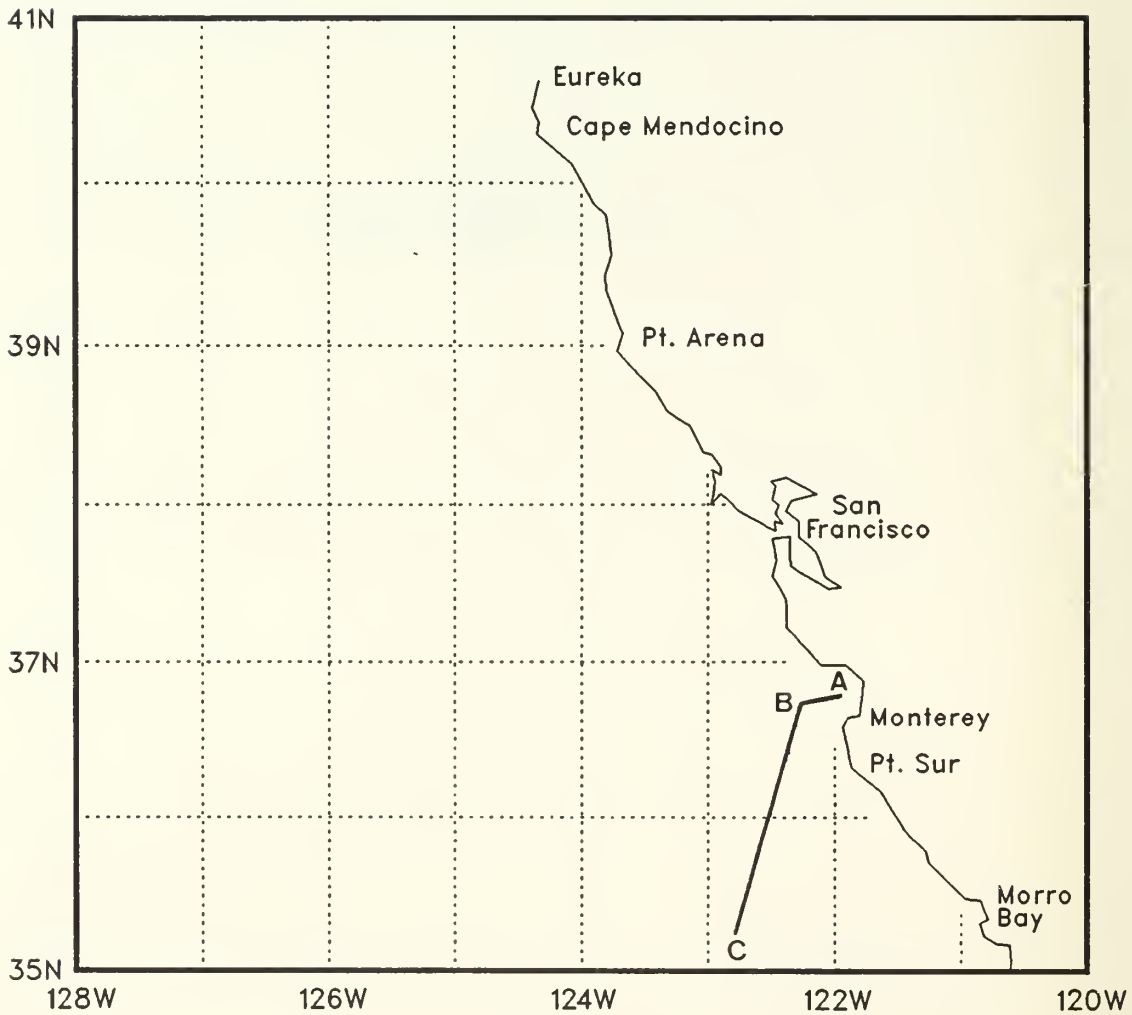


Figure 28: The cruise track for OPTOMA10.

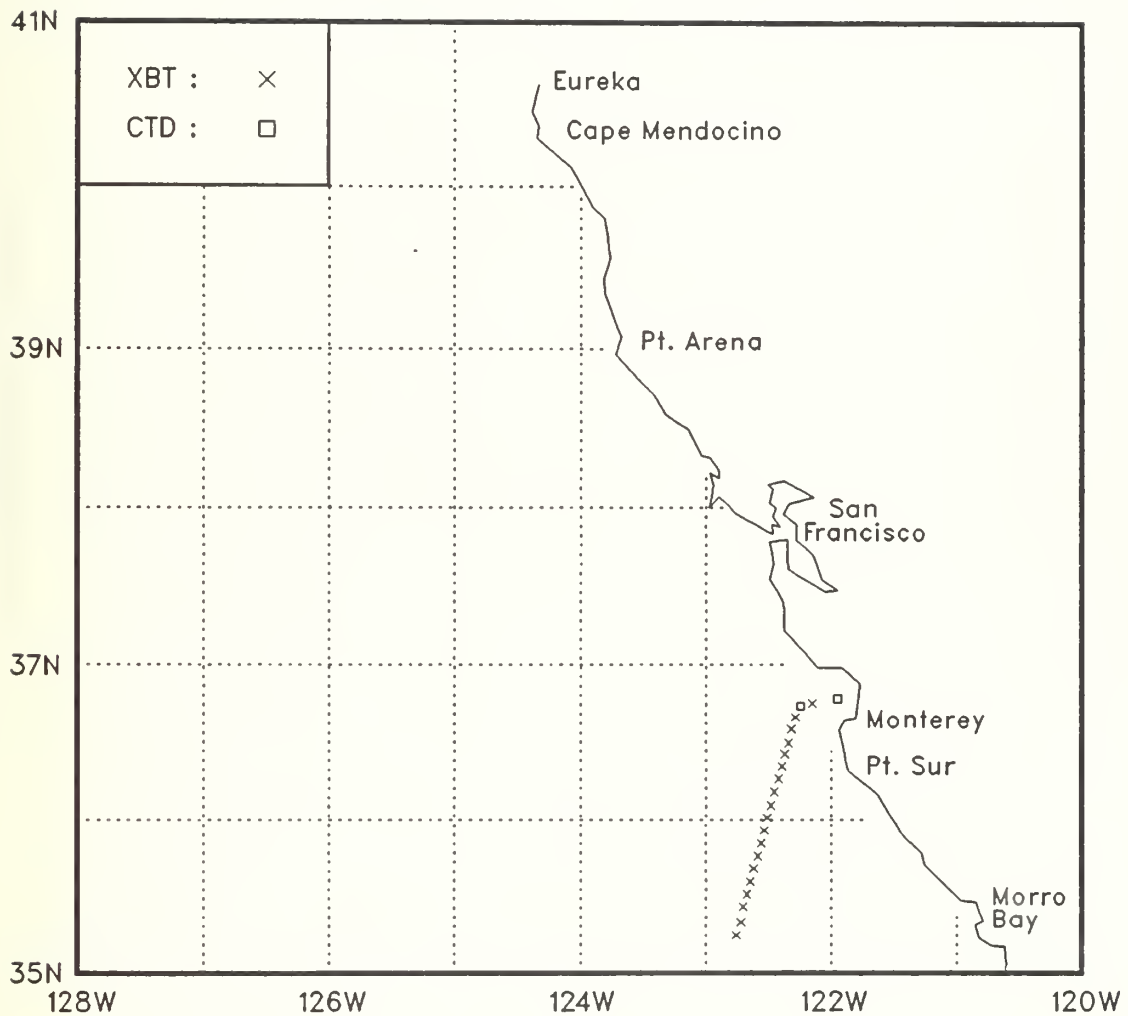


Figure 29: XBT and CTD station locations for OPTOMA10.

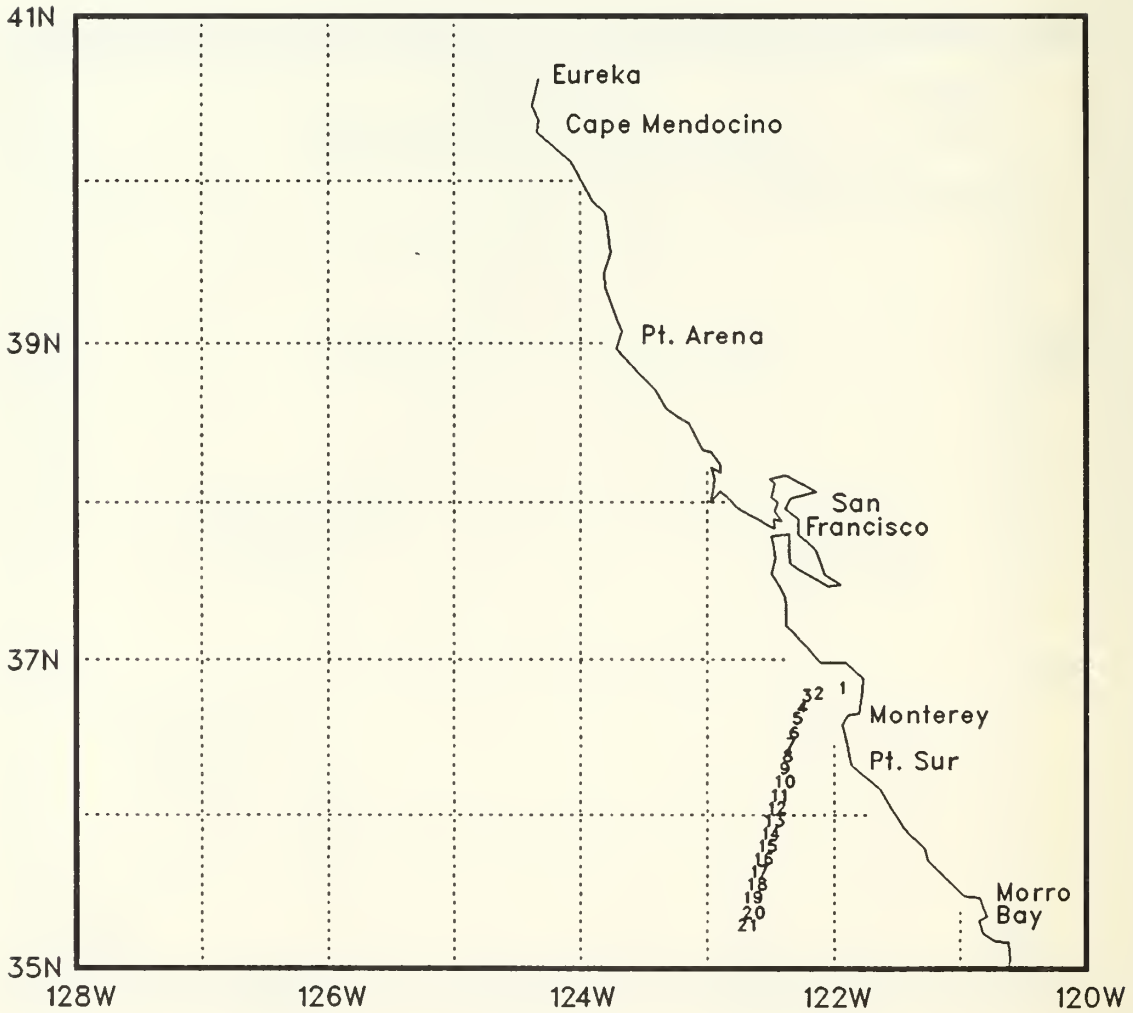


Figure 30: Station numbers for OPTOMA10.

Table 4: OPTOMA10 Station Listing

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)
1	CTD	84114	1029	36.47	121.57	10.2	33.55
2	XBT	84114	1243	36.45	122.09	10.3	
3	CTD	84114	1409	36.44	122.15	10.7	33.55
4	XBT	84114	1441	36.40	122.17	11.5	
5	XBT	84114	1515	36.35	122.19	11.6	
6	XBT	84114	1558	36.30	122.20	11.8	
7	XBT	84114	1632	36.26	122.22	12.1	
8	XBT	84114	1708	36.21	122.23	12.1	
9	XBT	84114	1746	36.16	122.25	12.2	
10	XBT	84114	1829	36.11	122.27	12.1	
11	XBT	84114	1908	36.06	122.29	12.2	
12	XBT	84114	1950	36.01	122.30	12.3	
13	XBT	84114	2029	35.56	122.32	12.7	
14	XBT	84114	2111	35.51	122.33	13.1	
15	XBT	84114	2153	35.46	122.35	12.7	
16	XBT	84114	2239	35.41	122.37	12.7	
17	XBT	84114	2330	35.36	122.38	12.9	
18	XBT	84115	21	35.31	122.40	13.0	
19	XBT	84115	118	35.26	122.42	12.7	
20	XBT	84115	218	35.20	122.43	12.5	
21	XBT	84115	307	35.15	122.45	12.6	

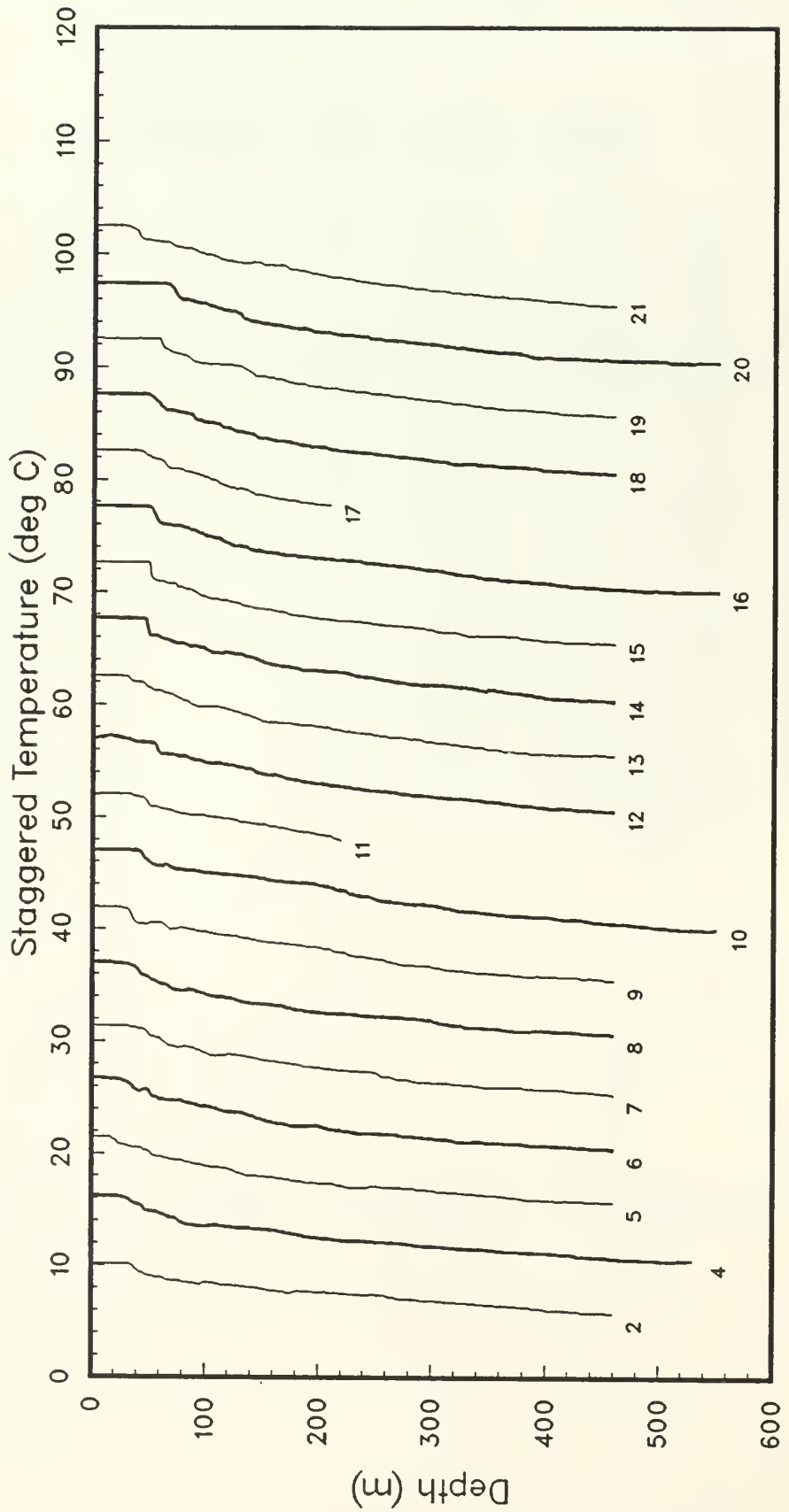


Figure 31: XBT temperature profiles, staggered by multiples of 5C. (OPTOMA10).

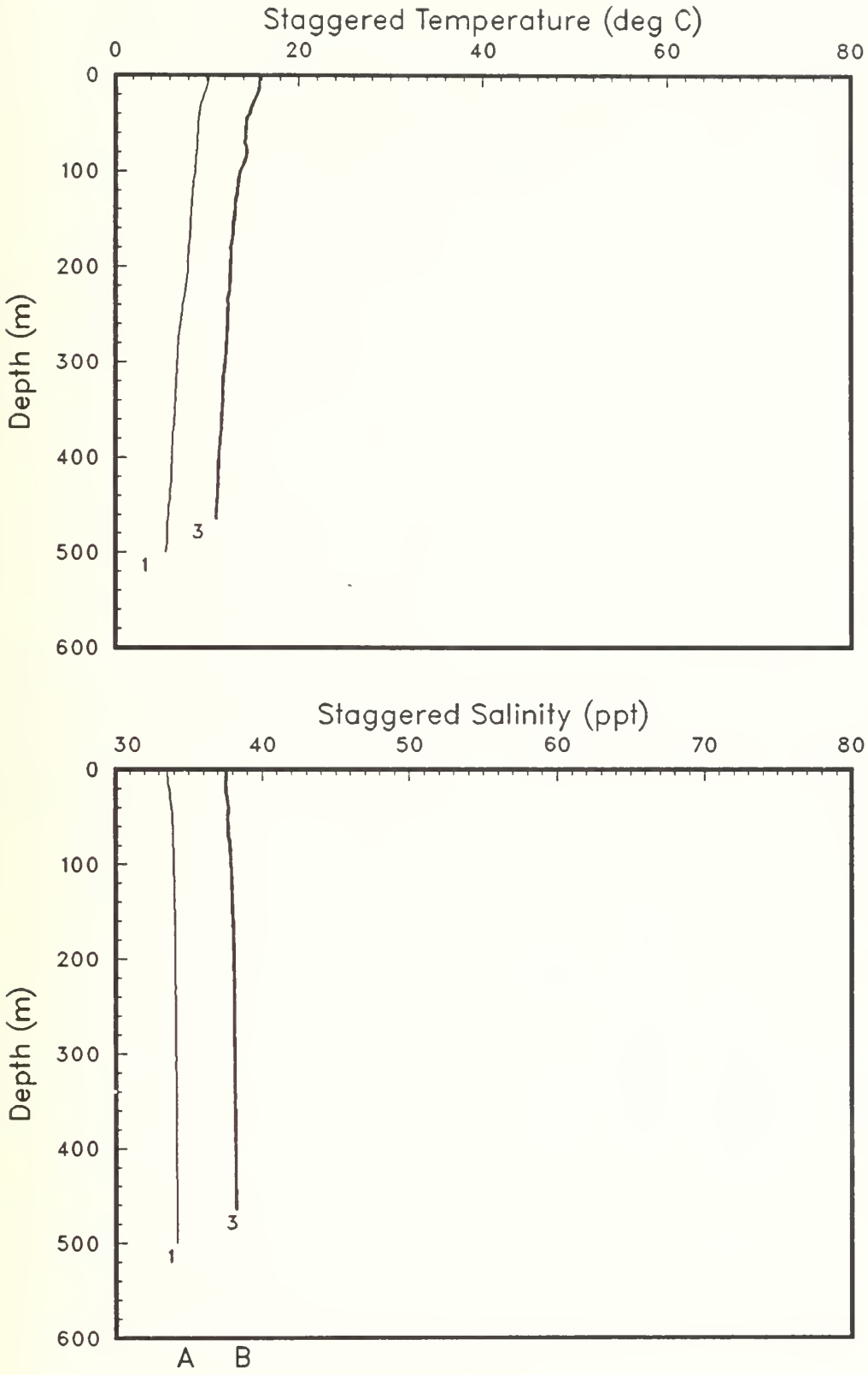


Figure 32: CTD temperature profiles, staggered by multiples of 5C, and salinity profiles, staggered by multiples of 4 ppt. (OPTOMA10).

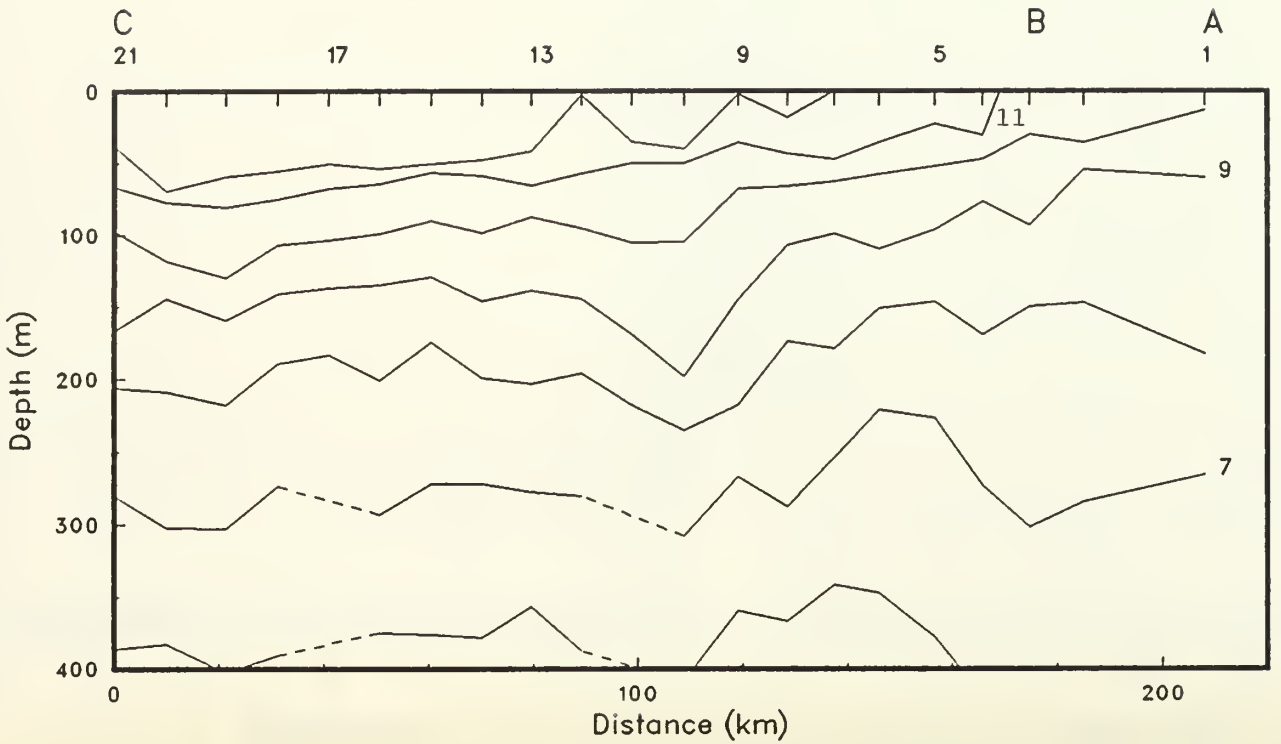


Figure 33: Along-track isotherms. Tick marks along the upper horizontal axis show station positions. Some station numbers are given. Dashed lines are used if the cast was too shallow. (OPTOMA10).

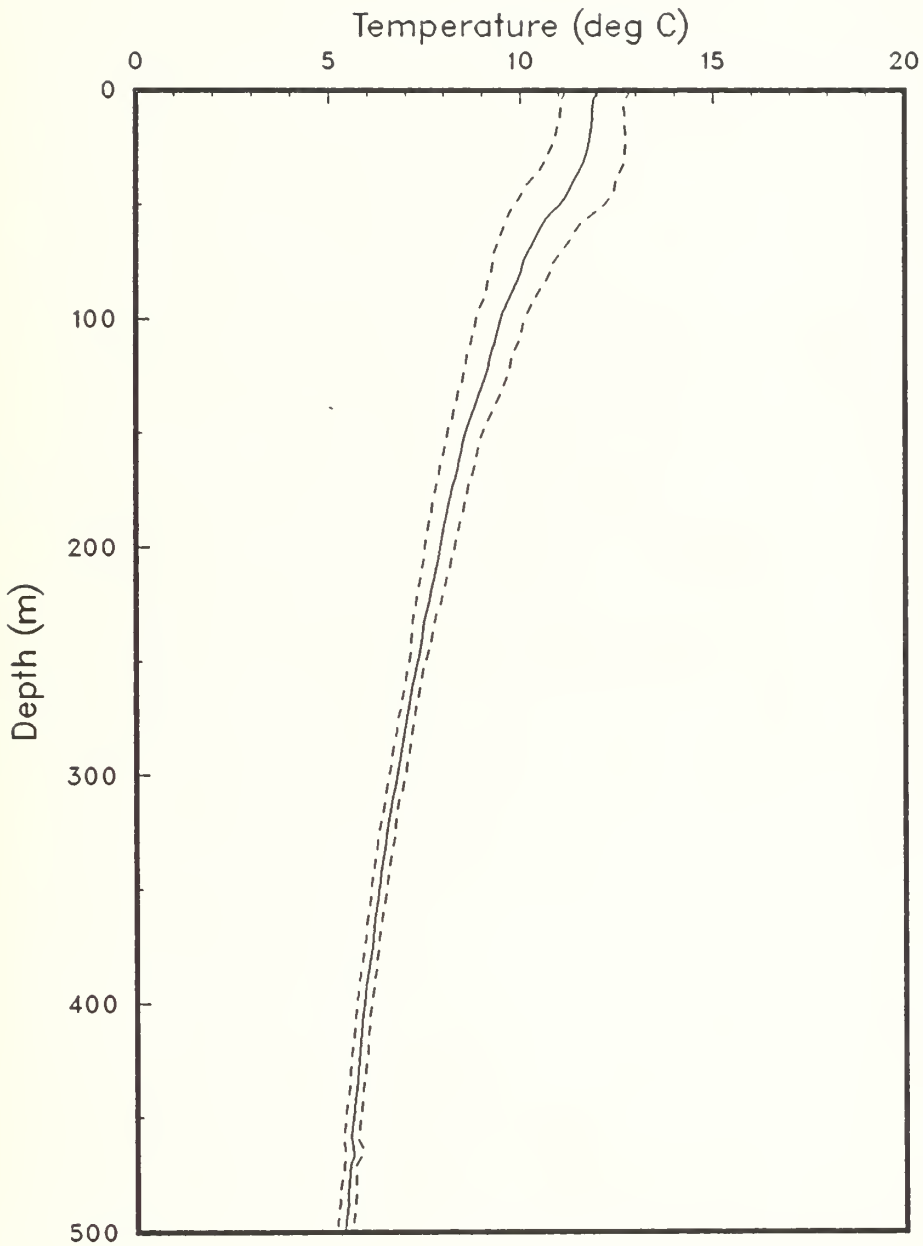


Figure 34: Mean temperature profile, with + and - the standard deviation. (OPTOMA10).

ACKNOWLEDGEMENTS

This research was sponsored by the ONR Physical Oceanography Program. The success of the fieldwork was strongly dependent on the competent, willing support of Captain Steve Bliss and other crew members of the R/V ACANIA. Members of the scientific cruise party were:

OPTOMA9 : Ms. Marie C. Colton, Co-Party Chief, NPS
Mr. Paul Wittmann, Co-Party Chief, NPS
AGAN Mary White, FNOC, USN
Ms. Elzbet Diaz de Leon, UC Santa Cruz
Mr. Anthony Michaels, UC Santa Cruz
Mr. Michael Moore, UC Santa Cruz
Ms. Dorothee Teboul, UC Santa Cruz

OPTOMASF: Prof. Christopher N.K. Mooers, Chief Scientist
COMO Robert H. Shumaker, USN, NPS Superintendent
Mr. Paul A. Wittmann, NPS, Party Chief
Mr. Theodore H. Calhoon, NPS
Ms. Arlene A. Bird, NPS

OPTOMA10 Ms. Marie C. Colton, Co-Party Chief
Mr. Paul A. Wittmann, Co-Party Chief
Mr. Phil Pinto, UCSC
Ms. Susan Healy, UCSC
Ms. Kathy Lyons, UCSC
Ms. Laura McClelland, UCSC
Ms. Sally Aguirre, NEPRF

REFERENCE

Lewis, E.L. and R.G. Perkin, 1981: The Practical Salinity Scale 1978: conversion of existing data. Deep Sea Res. 28A, 307-328.

INITIAL DISTRIBUTION LIST

1.	Defense Technical Information Center Cameron Station Alexandria, VA 22314	2
2.	Dudley Knox Library Code 0142 Naval Postgraduate School Monterey, CA 93943	2
3.	Prof. C.N.K. Mooers, Code 68Mr Naval Postgraduate School Monterey, CA 93943	52
4.	Prof. Allan R. Robinson Division of Applied Sciences Pierce Hall, Room 100D Harvard University Cambridge, MA 02138	8
5.	Dr. Thomas W. Spence Office of Naval Research 800 N. Quincy St. Arlington, VA 22217	1
6.	Naval Postgraduate School Department of Oceanography, Code 68	
	ATTN: Dr. Michele M. Rienecker, Code 68Rr	1
	ATTN: Dr. Edward A. Kelley, Code 68Kp	1
	ATTN: Dr. Laurence C. Breaker, Code 68By	1
	ATTN: Dr. Mary Batteen, Code 68Bv	1
	ATTN: Ms. Marie C. Colton	1
	ATTN: Mr. Paul A. Wittmann	1
7.	Prof. R.L. Smith College of Oceanography Oregon State University Corvallis, OR 97331	1
8.	Dr. Denise E. Hagan Jet Propulsion Laboratory, Code 183-501 4800 Oak Grove Road Pasadena, CA 91109	1
9.	Commanding Officer Fleet Numerical Oceanography Center Monterey, CA 93943	
	ATTN: CDR John F. Pfeiffer, USN	1
	ATTN: LCDR Michael R. Frost, RN	1
	ATTN: Mr. R. Michael Clancy	1
	ATTN: Mr. Ken Pollack	1
	ATTN: Ms. Evelyn Hesse	1

10. SANDIA National Laboratories
    ATTN: Dr. Mel Marietta 1
    ATTN: Dr. Eugene S. Hertel 1
    Div. 6334
    Albuquerque, NM 87185

11. LCDR Craig S. Nelson, NOAA Corps 1
    Marine Products Branch, W/NMC21
    National Meteorological Center
    National Weather Service, NOAA
    Washington, DC 20233

12. Commanding Officer
    ATTN: Dr. Steve A. Piacsek 1
    ATTN: Dr. Dana A. Thompson 1
    ATTN: Dr. Harley C. Hurlburt 1
    ATTN: Dr. Alexander Warn-Varnas 1
    Naval Ocean Research and Development Activity
    NSTL Station, Bay St. Louis, MS 39525

13. Scripps Institution of Oceanography
    ATTN: Ms. C. Paden 1
    ATTN: Prof. R.E. Davis 1
    University of California, San Diego
    La Jolla, CA 92093

14. Prof. George L. Mellor 1
    Geophysical Fluid Dynamics Program
    Princeton University
    P.O. Box 308
    Princeton, NJ 08540

15. Dr. Robert N. Miller 1
    Department of Mathematics
    Tulane University
    6823 St. Charles
    New Orleans, LA 70118

16. LTJG Diane C. Durban, USN 1
    NAVOCEANCOMFAC Keflavik Iceland
    FPO NY 09571